INDIAN RAILWAYS

ONE HUNDRED YEARS

1853-1953


PAPER RAILWAYS INDIA
FLY SKETCH No. 2
MAP OF INDIA.
Containing Projects for Railways
J.P. KENNEDY
CHINESE TARTARY
BAY OF BENGAL
MOUTHS of the GANGES
CALCUTTA
CHITTAGONG
BOMBAY
MADRAS
CEYLON
GULF OF MANAAR
COROMANDEL
NORTHERN CIRCARS
CEDED DISTRICTS
RAJPOOTANA
Great Sandy Desert
Bikaner
BUNDELKUND
Nizam Dominions
GOPUCPOOR
of Nepal
Guicowar
KANDEISH
MALABAR


MAP OF RAILWAYS
IN
INDIA
Miles 100 80 60 40 20 0 100 200 300 Miles
The Indo Pakistan boundary shown on this map has not yet been demarcated as an international boundary. The alignment, therefore, is to be regarded as approximate and is not authoritative.
Railway
Indication
1. Southern
2. Central
3. Western
4. Northern
5. North Eastern
6. Eastern
RAWALPINDI
SIMLA
NAINITAL
DELHI
GWALIOR
JHANSI
BHOPAL
NAGPUR
BOMBAY
CENTRAL
HYDERABAD
SECUNDERABAD
RAICHUR
MADRAS
COLOMBO FORT
Mt. Everest
BAY
OF
BENGAL
NARBADA R.
GODAVARI R.
KISTNA R.

INDIAN RAILWAYS
ONE HUNDRED
YEARS

The Crest of the Indian Railways

INDIAN RAILWAYS
ONE HUNDRED YEARS

1853 to 1953

सत्यमेव जयते

NEW DELHI
Ministry of Railways (Railway Board)
Government of India
1953

Written by

J. N. Sahni

The book is based on factual information relating to the history of construction, technical aspects of working and other details supplied by the Ministry of Railways, supplemented by additional data collected by Shri Sahni from other sources, and during his visits to important railway centres. The views expressed in this Volume do not necessarily represent the views of the Ministry of Railways.

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FOREWORD

INDIAN RAILWAYS will be completing One Hundred Years of development and working on 16th April 1953. During the century covered by this work, Indian Railways have played an important part in the economic, social and political life of the country. Railways have abridged distances and have brought the producers in distant and previously inaccessible areas into close contact with the great consuming centres in India as well as abroad. They have assisted in the process of specialisation in production, the growth of large-scale enterprise, and the steady industrial transformation of the country. Indian Railways thus epitomize the nation's economic development during the past century.

In the succeeding pages the reader is taken to the earliest beginnings of railway construction in India. The later phases of expansion and development, the problems and difficulties which had to be faced in the process, and the final emergence of Indian Railways as the largest nationalised undertaking in the country, are described in a style intelligible to the non-technical reader. The various aspects of railway working are discussed in fair detail. All these ought to provide an absorbing account of the history of Indian Railways.

At the threshold of the second century of their history, Indian Railways are participating in the nation's Five Year Plan designed to secure self-sufficiency in food production, accelerated rate of industrial expansion, and all-round economic development in various other sectors. As alternative modes of transport, such as, waterways and the roads, have not developed in India to the extent they have in other countries, Indian Railways will continue to function as by far the most important means of inland transportation in this country for many years to come. The task of the Railways is, therefore, going to be heavier than ever before with

their having to cope with the new responsibility which will devolve on them in the coming years. From what I have seen of the achievements of the Indian Railways since the attainment of Independence, I am full of hope that they would serve better still and I can confidently say that their contribution to the future economic progress of the country will be even more than it has been in the past.

It is essential that these facts relating to a national enterprise of such vital importance to the economic progress of the country should be widely known and appreciated. I, therefore, hope that this volume will be read with considerable interest by all sections of the people, not only in this country but also elsewhere, who are interested in the history, progress, and present working of Indian Railways.

Lal Bahadur

Minister for Transport and Railways
Government of India

NEW DELHI
25*th March* 1953

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I. The Beginning

AN AVERAGE PERSON has come to take the railways for granted; almost like the hills, the rivers, the lakes, the forests and other similar permanent factors in his normal existence. To think of life without railways conjures up the picture of a very primitive state of existence. It is hard to believe that railways, as we know them did not exist in any part of the world before 1825, and that the highest speed man could attain till then was in the saddle of the fastest horse.

'Nothing in the world can beat these messengers,' said Herodotus of the couriers in ancient Persia. This supremacy of the horse in terms of speed remained unchallenged till the dawn of the Railway Age. Today the total mileage covered by railways in different countries exceeds 770,000 approximately thirty times the circumference of the globe. Many of these lines are 'double track.' The total length of rails in use, is capable of constructing 35 parallel ways round the Equator. The yearly train world mileage is 6,200 million, equivalent to a journey from the Sun to the uttermost planet in our solar system, the Pluto, and back. Starting from a speed of ten miles an hour railways have attained a speed of 112·5 miles an hour, maintaining in one case an average of 100 miles per hour for a distance of 43 miles.

RAILWAYS IN INDIA

In India the railways cover 34,000 route miles of which a fairly large portion is laid with double track. Railways represent a capital investment of Rs 862 crores. Their gross earnings in 1951-52 were Rs 294 crores as against working expenses of Rs 228 crores. The annual train mileage covered was 188 million being 14 million miles more than the distance between the Sun and Mars. During the same year railways carried 98 million tons of goods and nearly 1,232 million passengers. The cost of coal alone, consumed by railways, during this period was Rs 30·4 crores representing a tonnage of 10·8 million.

Modern railways present an extraordinary integration of high administrative efficiency, technical skill, commercial enterprise and resourcefulness. They are one of the most specialised industries of the world. The permanent way, bridges, viaducts, culverts, tunnels, stations, marshalling yards, sheds, signals, steam, diesel

and electric locomotives, coaches, wagons, rail motors, steamers, telephones, wireless and telegraph equipment, power houses, workshops, printing presses, coal mines, hotels and restaurants, hospitals, store depots, marine establishments, etc, are some of the major items which go to make up a modern railway system.

HUNDRED YEARS AGO

A hundred years ago, on the 16th April 1853, the first railway ran over a stretch of 21 miles from Bombay to Thana. This event made history!

The idea of a railway to connect Bombay with Thana, Kalyan and with the Thal and Bhore Ghats inclines first occurred to Mr George Clark, the Chief Engineer of the Bombay Government, during a visit to Bhandup in 1843. A meeting of prominent citizens was later held at Bombay on 13th July 1844, Sir Erskine Perry, Chief Justice, presiding, 'to consider the advisability of having a railway to be named the Bombay Great Eastern Railway, constructed from Bombay to the Thal Ghats and Bhore Ghats *via* Salsette, in accordance with Mr Clark's scheme.'

Mr George Clark, in the meantime, had prepared detailed plans for a line from Kurla to Thana. This scheme was investigated by a special committee headed by the Chief Secretary, Mr Henry Conybeare, and approved by a meeting of the citizens of Bombay held at the Town Hall on 19th April 1845. Colonel G. R. Zervis presided. A railway association was formed for carrying out the scheme.

At the same time through the efforts of John Chapman and Messrs White and Barnett, Solicitors, Whitehall Place, London, a fresh company was formed in England called the Great Indian Peninsula Railway Company and its first prospectus was issued on 15th July 1844. According to a manuscript record left by Sir Jamsetjee Jeejeebhoy, Baronet, one of the first Indian Directors of the Great Indian Peninsula Railway Company, George Stephenson, the great British locomotive inventor (1781-1848) was among the first directors of the Company. His son, Robert Stephenson (1803-59), was appointed Consulting Engineer. Later, an influential committee was formed in Bombay to work in conjunction with the London Committee to give effect to the scheme. The Great Indian Peninsula Railway Company was thereafter incorporated in England by an Act of 1st August 1849, and the contract between the Court of Directors and the Railway Company requesting the company to raise a capital of £500,000 was made on 17th August 1849. On 14th November 1849, Mr J. J. Berkeley was appointed Chief Resident Engineer. He arrived in India in February 1850, and devoted full twelve months to survey the line.

THE FIRST SOD IS TURNED

From then onwards events moved at a fast pace. On 31st October 1850 the

ceremony of turning the first sod for the Great Indian Peninsula Railway from Bombay to Kalyan was performed by the Honourable Mr J. P. Willoughby, Chief Justice of Bombay, at a place near Sion, in the presence of a large number of notable citizens. This was the first ceremony ever performed in India of laying a railway line, or for that matter in any country in the Middle and Far East. In 1851 a contract was entered into with Messrs Fariell and Fowler, an English firm for the construction of the railway line to Thana. The firm employed as many as 10,000 workers on constructional work.

On 18th February 1852, the first locomotive was witnessed shunting near Byculla flats in Bombay. The engine made its start from a coppice then known as 'Phips O'art' and the scene of its daily shunting became a perfect fair for large crowds of men, women and children. The locomotive was later named 'Falkland' after Lord Falkland (1848-53), the then Governor of Bombay. On 18th November 1852, the Company's Directors with some of their friends travelled in the first railway train from Bombay to Thana covering the distance of 21 miles in 45 minutes. They took their breakfast in the Kurla tunnel, the first railway tunnel to be built in India, near Thana.

THE FIRST TRAIN

The formal inauguration ceremony was performed on 16th April 1853, when 14 railway carriages carrying about 400 guests left Bori Bunder at 3-30 pm 'amidst the loud applause of a vast multitude and to the salute of 21 guns.' The Governor's band was present, but not His Excellency the Governor. According to the *Bombay Times*,

> 'The Governor, Lord Falkland and the Commander-in-Chief, Lord Frederick Fitz Clarence, with their respective attendants accompanied by the Bishop, the Reverend John Hardinge, left for the hills the evening previous in disregard of the memorable character of the occasion.'
>
> 'The day,' further reports the paper, 'was observed as a public holiday by all Government offices and banks, etc.'

The party reached Thana at about 4-45 pm where refreshments were served in tents and Major Swanson wished success to the new Company and its Chief Engineer, Mr Berkeley. The guests returned to Bombay at 7 pm on 17th April 1853. The next day Sir Jamsetjee Jeejeebhoy, second Baronet, reserved the whole train, and travelled from Bombay to Thana and back, along with some of the members of his family.

His Excellency the Governor then Lord Elphinstone was, however, present a year later when the line was extended to Kalyan. He performed the opening ceremony on 1st May 1854. This extension, according to engineering standards then existing, was a difficult and outstanding achievement. It required a two-line viaduct over the estuary to the mainland and two tunnels which with the exception

of a small road tunnel near Satara were the first works of any magnitude undertaken by the East India Company in the Bombay Presidency. The cost was estimated at Rs 84,000 per mile.

The railway line from Kalyan to Khopoli was opened on 12th May 1856, while the line from Khandala to Poona was opened to traffic on 14th June 1858. The distance between Khopoli to Khandala could still only be traversed by a palanquin, pony or cart. This line was completed in 1862. The Kasara line was opened on 1st January 1861, and the Thal Ghats incline up to Igatpuri was officially opened by Governor Sir John Bartle Frere on 30th December 1864. This completed one of the most difficult projects in railway history, and set the basis for railway expansion in India.

HOWRAH TO HOOGHLY

The first passenger train steamed out of Howrah station destined for Hooghly, a distance of 24 miles, on 15th August 1854. Thus the first section of the East Indian Railway was opened to public traffic, inaugurating the beginning of railway transport on the eastern side of the sub-continent. Mr (later Sir) Rowland Macdonald Stephenson, who became the first Agent of the East Indian Railway Company, brought the Company into being in London in 1844. In the cold weather of 1845-46 a trial survey was made by him from Calcutta to Delhi after which he went home to place his proposals before the Board of Directors and the Honourable East India Company. After three years of discussion and exchange of notes between the various authorities concerned, the building of the railway to Raniganj was sanctioned as 'an experimental measure'. Of this period Stephenson wrote when he returned to India in 1850: 'Active operations have now at the close of 1850 scarcely commenced. The interval has been occupied with discussions, doubts, objections and their solution and removal.'

It may be of interest to mention that the railway mania had invaded Calcutta as early as 1845-46, and a project from Calcutta to Bhagwangola, on the Ganga, was put forward in a colourful prospectus of a Company to be started with a capital of £1,500,000. It was called the Central Bengal Railway Company. Money was subscribed by several people in Calcutta and, according to a newspaper report, 'a splendid entertainment was given at the Town Hall by the promoters to celebrate the event. Shortly afterwards the promoters and the money both disappeared.'

TWO MISHAPS

By the end of 1853 through the efforts of Macdonald Stephenson the line was ready up to Pundooah (38 miles), but two serious mishaps prevented the running of the first train till a year later. The ship bringing the first models of railway carriages, *HMS Goodwin* sank at Sandheads. The ship bringing the first loco-

Above : A view of Thana Harbour in 1853.

Left : The first railway train passing over the original Thana Bridge.

Note :—These photographs along with a few others on following pages are from the Jeejeebhoy collection from the library of Sir Jamsetjee Jeejeebhoy, Second Baronet of Bombay, and reproduced by the kind permission of Mr. J.R.B. Jeejeebhoy.

Below : A cosmopolitan group of passengers waiting for the train on Byculla station in 1854. (Reproduced by courtesy of 'The Illustrated London News').

Above : Cotton bales lying at the Bombay Terminus of the Great Indian Peninsula Railway ready for shipment for England, 1862. (Reproduced by courtesy of 'The Illustrated London News').

Below : A panoramic view of the railway line, viaducts and tunnels on the Bhore Ghats incline. (Jeejeebhoy's collection).

motives was misdirected to Australia. The French possession of Chandernagore, presented another unforeseen difficulty. The French boundary was then apparently not clearly defined and the railway was found to be encroaching on French territory. It was some time before the boundary dispute could be resolved.

Mr John Hodgson, the East Indian Railway Locomotive Chief Engineer, finding that the carriage models had been lost, set about building carriages locally. This was done by two Calcutta coach-building firms of Messrs Steward and Company and Seton and Company. The locomotive reached Calcutta *via* Australia by *HMS Dekagree* in 1854 and soon afterwards on 28th June was taken on a trial trip by Mr Hodgson from Howrah to Pundooah. The railway was opened as far as Hooghly, a distance of 24 miles, on 15th August and up to Pundooah on 1st September 1854. On Saturday, 3rd February 1855, the line was opened up to Raniganj as originally planned.

Howrah, in 1853, could be reached from Calcutta only by boat. It was many years later that a pontoon floating bridge was built by Sir Bradford Leslie and direct vehicular traffic established. This bridge was dismantled a few years ago to give place to the new Howrah bridge which is one of the finest single span cantilever bridges of its kind in the world. Howrah then, itself was little more than a village. The site on which the new railway station now stands was a jumble of railway stores with sheds for the workshops of the locomotive department and for construction of carriages. A temporary shed was constructed at this place to serve as the station. One small pigeon hole window served as the 'booking office' where tickets were issued for all classes.

JOURNEY TO HOOGHLY

Three thousand applications were received from those who wanted to ride in the first train. Only a few hundred could be accommodated. The first train which left Howrah for Hooghly on 15th August 1854 was full to capacity. For various reasons the official opening of the line could not take place till the next year, but the event created a great deal of popular enthusiasm, and several thousands cheered the train on its first journey. The train left Howrah station at 8-30 am and reached Hooghly in 91 minutes. It consisted of three first class, two second class, three trucks for third class passengers, and a brake van for the Guard, all constructed in India. The first class fare was three rupees and the third class seven annas.

The official opening of the railway took place on Saturday, 3rd February 1855. Burdwan was chosen as the scene of festivities. Lord Dalhousie, the then Governor-General, 'on account of indisposition' could not undertake the journey for the official opening, but attended a service in this connexion at Howrah station. The party invited for the occasion consisted of nearly a

thousand guests who after the inaugural ceremony by the Governor-General left in two trains for Burdwan traversing the distance in two hours and 50 minutes.

In South India the first line was opened on 1st July 1856 by the Madras Railway Company. It ran between Veyasarpaudy and Walajah Road (Arcot) a distance of 63 miles.

In the North a length of 119 miles of line was laid from Allahabad to Kanpur on 3rd March 1859 and three years later the Amritsar-Atari section, the northernmost part of the line, between Amritsar and Lahore was opened to traffic. At this stage the construction of lines now constituting the North Eastern Railway was just beginning. The first section from Hathras Road to Mathura Cantonment was opened to traffic on 19th October 1875, to be followed by the section Kanpur to Farukhabad in the winter of 1880-81. Next came the section in the extreme east Dibrugarh Town to Dinjan opened on 15th August 1882. Construction was also going on further inland, by the Bengal and North Western Railway where the first section to be opened was Darbhanga to Jhanjharpur on 1st February 1883, to be followed, three months later, by the sections Bachhwara to Barauni and Barauni to Semaria Ghat.

These were the small beginnings which in due course developed into a network of railway lines all over the country. By 1880 the Indian Railway System had a route mileage of about 9,000 miles.

WORLD'S FIRST TRAIN

The first Indian Railway rolled on its tracks just 28 years after the world's first train had made its initial successful run. This was in England. The first train, consisting of 38 carriages laden with passengers and goods ran between Stockton and Darlington in 1825. The railway line was actually commenced in 1821 by the famous inventor of the steam locomotive, George Stephenson, but it took four years to complete the construction.

In France, railways started in 1829, in Germany in 1835, in Holland and Italy in 1839 and in Spain in 1848. The construction of the first railway from St. Petersburg, now Leningrad, to the suburbs of Pavlovask was completed by a private company in 1837. The first railway in the United States was opened on a section of 15 miles of the Baltimore-Ohio line in May 1830. Initially it was operated by horses and later locomotives were employed.

OPPOSITION AND PREJUDICE

Like any other invention, in the early stages the railways had to overcome a great deal of prejudice, opposition and popular criticism. It was difficult to convince common people that a journey by rail was safer than by stage coach. There is the story of a German doctor who declared that ' it would be impossible for people

to watch the trains pass along without going mad, and unless hoardings were erected the cow's milk would turn sour.'

It was not till 13th June 1842, seventeen years after the opening of the first railway line in England that Queen Victoria advised by her Ministers deemed 'it safe' to take a journey from London to Slough. Even at this time the hazardous adventure of Her Majesty was looked upon with apprehension and critical disapproval by some of her 'loyal subjects.' *The Atlas* while complimenting the Queen for her courage apprehended that

> 'a long Regency in this country would be so fearful and tremendous an evil that we cannot but desire, in common with many others, that these Royal excursions should be, if possible, either wholly abandoned or only occasionally resorted to.' Concluding, it said, 'There is danger by the railway ; and, therefore, the Queen should be occasionally exposed to it.'

Louis Phillip of France, as late as 1848, was practically forbidden to 'endanger' his life on the railway. *Le Commerce* tells the story:

> 'When the king was intending to go with the Royal family to his Chateau at Bizy he proposed to be conveyed by a special train on the railways as far as Rouen and orders were given to this effect. But the Council of Ministers on being acquainted with His Majesty's project, held a sitting, and came to the resolution that this mode of travelling by railway was not sufficiently secure to admit of its being used by the King and consequently His Majesty went to Bizy by post-horses.'

In England as late as 1835, *John Bull* denounced the railways as a menace.

> 'If they succeed' wrote the paper, 'they will give an unnatural impetus to society, destroy all the relations which exist between man and man, overthrow all mercantile regulations, overturn the metropolitan markets, drain the provinces of all their resources, and create at the peril of life, all sorts of confusion and distress. If they fail, nothing will be left but the hideous memorials of public folly.'
>
> It further remarked : 'Does anybody mean to say that decent people...would consent to be hurried along through the air upon a railroad, from which, had a lazy schoolboy left a marble, or wicked one a stone, they would be pitched off their perilous track into the valley beneath;.......being at the mercy of a tin pipe or a copper boiler, or the accidental dropping of a pebble on the line of way?.....We denounce the mania as destructive of the country in a thousand particulars.....the whole face of the kingdom is to be tattooed with these odious deformities—huge mounds are to intersect our beautiful valleys ; the noise and stench of locomotive steam-engines are to disturb the quietude of the peasant, the farmer and the gentleman ; and the roaring of the bullocks, the bleating of sheep and the grunting of pigs to keep up one continual uproar through the night along the lines of these most dangerous and disfiguring abominations.'

It is hardly surprising that many people in India should in the early stages have also opposed the introduction of railways as a 'hazardous and dangerous venture,' or at best a 'premature and expensive undertaking.' There were many among Britishers in England and in India who felt that even if the railways could be

started it would be difficult for them to get any passengers. Doubt was expressed 'whether people would be attracted from the bullock cart to the rail and whether religious mendicants, fakirs, agricultural labourers and other more or less destitute folk who did not "possess an anna" could be persuaded to pay a train fare rather than prefer to meander without any sense of time.' Romesh Chandra Dutt, the great Indian economist, was among many Indians who considered railways as 'a wasteful expenditure' and at best deserving of secondary priority next to roads and canals. 'Englishmen in their own country,' wrote R. C. Dutt, 'were more familiar with railroads than with canals, and they made the mistake of judging the needs of Indians accordingly.' This view was endorsed in subsequent years even by Sir Arthur Cotton, the architect of the magnificent Kaveri and Godavari irrigational works. In tendering evidence before a Parliamentary Committee he remarked:

> 'My great point is this that what India wants is water carriage, that the railways have completely failed, they cannot carry at the price required, they cannot carry the quantities, and they cost the country three million rupees a year, and increasingly to support them.'

Lord Lawrence at one time Governor-General of India, advocated the need for more irrigation works and 'believed irrigation to be infinitely more important for the wants of the country than railways.' Some experts held the view

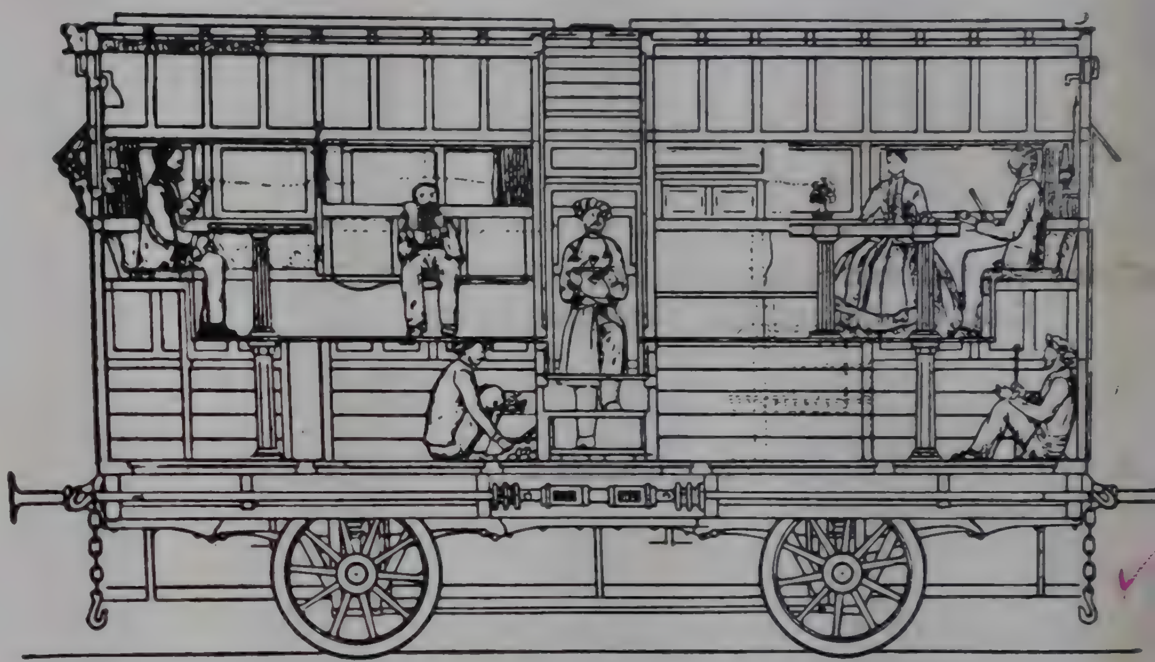
> 'that the climate of the country would be a most serious obstacle. There was the fear of the disastrous effect of periodical rains, of violent winds and a vertical sun. The damage that would be caused by insects and vermin to the banks and the timber sleepers was dwelt on, as well as the effects of tropical vegetation while a more reasonable and valid objection was raised, in the difficulty which would be experienced in finding competent engineers and workmen for constructing and working railroads in India.'

NATURAL DIFFICULTIES

There were besides other great and formidable obstacles created by nature and by physical conditions. India was not a flat country like Russia where Czar Nicholas could sit down with a foot rule and a map of the country, draw two straight lines between Moscow and St. Petersburg and dictatorially declare 'This is the route which the railway line should take.' Nor was India such a small country as England. Apart from being a sub-continent, India was a country presenting several physical difficulties. Several surveys made by experts and engineers, like Mr Simms, who was sent out in September 1845, and Mr Robert Stephenson, who came to India a year later, and others, finally led to the view that the numerous difficulties pointed out by the opponents of railway construction notwithstanding, railway lines could be successfully laid to connect the various parts of India and that railways could be run safely and profitably under existing Indian conditions.

Above : The first railway train on the East Indian Railway. (Reproduced by courtesy of 'The Illustrated London News').

Above : The four-wheeler saloon constructed for the use of the Prince of Wales (the late King Edward VII) when he visited India in 1876.

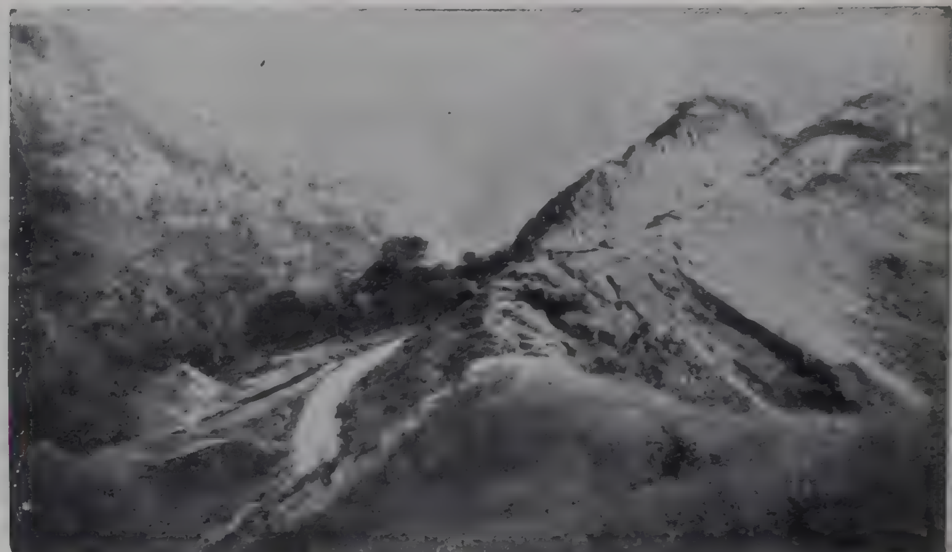


Above : A diagram of the design of construction of a luxury double-decker saloon constructed in India in 1863 for use by the Governor of Bombay. Architects and engineers were rightly proud of their achievement when this deluxe coach was built.

Below : An inside view of one of the earliest first class carriages on Indian Railways. (Reproduced by courtesy of 'The Illustrated London News').

Above : The first train entering the eastern tunnel on the Great Indian Peninsula Railway. (Jeejeebhoy's collection).

Above : A Panoramic view of Khandala. (Jeejeebhoy's collection).
Below : The 'Duke's Nose' on the Bhore Ghats incline. (Jeejeebhoy's collection).



Below : A view of the Ghats near Khandala. (Jeejeebhoy's collection).

Below : An unexpected danger. An engineer's predicament. (Reproduced by courtesy of 'The Illustrated London News').
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The Saraswati Bridge near Hooghly—1853. (With acknowledgement to 'Bengal Past and Present').

East India Railway.

ON and after Tuesday the 15th instant, Trains will leave Howrah and Hooghly stopping at Bally, Serampore, and Chandernagore, at the following hours :

	h. m.		h. m.
From Howrah	10-30 A. M.	and	5-30 P. M.
" Hooghly	8-23 A. M.	and	3-38 P. M.

On and after the 1st September, the Trains will run between Howrah and Pundooah, stopping at all the Stations.

Parties wishing to avail themselves of Monthly Tickets at reduced rates are requested to apply at any of the Stations for Forms, to be filled up in writing and forwarded to the Managing Director and Agent as soon as convenient.

The Rate of charge will be fixed hereafter.

The Monthly Tickets will not be issued before 1st January next.

R. MACDONALD STEPHENSON,
Managing Director and Agent.

29, Theatre Road,
Calcutta, 12th August, 1854. (891—N. S.)

The Bengal Hurkaru and the India Gazette, Calcutta, 14-8-1854.

Railway charges.

To the Editor of the Citizen.

SIR,—I hear many complaints being made about the Railway. Considering this is a very cheap country for travelling and the natives of this country seem by no means inclined to give up their old *jogging-[illegible] a day* system of travelling, I think that the rates might be lowered. The Company would benifit by it in the long run. Four Rupees from here to Hooghly, a distance of only 28 miles. It might be lowered safely to 3. Many persons whom I know would gladly have availed themselves of the Railway mornings and evenings as it was their intention of taking houses near Chinsurah and Hooghly; but they think that the rate of travelling is rather too much.

A day we may well say has dawned upon India which bids fair to class this country with any in civilized Europe. Telegraph and Railway ministers already go hand in hand—what may we not hope in time? Young Bengal is becoming so accustomed to our language, that he must read edit, and publish papers. I have always found that in all great undertakings, for the time something is overlooked which is considered too trifling to notice; but which invariably attracts notice from its *[illegible]ableness* if I may so say; which bears out what I have stated relative to the high rates of the Railway Company. An insertion of this letter will oblige,

Yours faithfully,
RECORDER.

Calcutta, 12th August, 1854.

The Citizen (Daily), Calcutta, 14-8-1854.

The Bengal Hurkaru and the India Gazette, Calcutta, 16-8-1854.

THE RAILWAY.—There are at present about five Locomotives set up across the water for immediate use, and it is said that *seventy* more are to come out from England.

Of the carriages which ran yesterday one was entirely engaged by a native gentleman, and another by Mr. Shircore, of the Assignee's Office.

Lord Dalhousie who played a very important part in shaping the early policy of railway construction in India, in a historic minute written in July 1850 from the hill station of Chini, in the Himalayas, stated that while he had doubts 'as indeed every one at that time,' as to whether the railways could be made to pay in India, he was most anxious that 'this so-called "experimental" line should prove a success.' He was then referring to the proposed East Indian Railway line between Calcutta and Rajmehal. He said that its object—

> 'is to prove, not only that it is practicable to construct railways in India, as engineering works, but that such railways, when constructed, will, as a commercial undertaking, offer a fair remunerative return on the money which has been expended on their construction.'

Within three years of his writing this note the first railway started running between Bombay and Thana. Thus a hundred years ago was initiated what has now become a stupendous enterprise, through the efforts of some farsighted men who realised and insisted that there was in the construction of railways in India the potentialities of a tremendous development for the country.

II. A Network is Built

MAJOR HIGHWAYS in India had for centuries radiated from such inland centres as Delhi, Lahore, Allahabad, Agra, etc, towards the sea coast. The process was reversed in regard to railways. The first railways, except in the north, started from the three major seaports, Bombay, Calcutta and Madras and extended into the interior of the country. Both as towns and as seaports these three were hardly of any importance before the advent of the East India Company.

The earliest proposals for constructing railways in India were made in 1843-4 for the East Indian Railway Company by Sir Macdonald Stephenson. Plans for starting railways from Bombay and Madras were put forward simultaneously, and surveys of all the three prospective routes were undertaken almost at the same time.

THE MOUNTAINS

The task of the early builders, however, was not an easy one. Their first major hurdles were the physical obstacles which had to be encountered and overcome. Beyond Kalyan on the western route stood the Thal and the Bhore Ghats. These Ghats consisted of a continuous deep chain of massive, solid impregnable rocks and lofty peaks, rising abruptly to heights from two to four thousand feet. Except for a few horse tracks and a rough craggy road serviceable during a few months of the year for carts, the Ghats were a mass of thick impenetrable jungle infested with wild beasts and many varieties of dangerous reptiles, having a climate unfit for human habitation. Beyond the Ghats after a few hundred miles of up-country lay the Vindhyachal Mountains blocking the route to the north and the east on the one hand, and to the south on the other.

THE RIVERS

The physical obstacles on the eastern route were of a different variety. The Indo-Gangetic Plain, stretching between Calcutta and Delhi, except for a few hilly tracts in the Chota Nagpur area, was an ideally flat country. Here and there, it is true, lay long stretches of marsh and jungle which had to be cleared

before the track could be laid. But the chief hurdle in this area was the rivers. The Hooghly, the Brahmaputra, the Padma, the Ganga, the Jamuna, the Mahanadi, the Narbada, the Godavari and a whole network of their tributaries and seasonal torrents required the best skill of engineers, a great deal of costly material and a large number of trained labourers to build bridges over their untamed waters. From mere streams in ordinary times, these rivers when in flood assumed enormous dimensions.

In the north the line connecting Delhi with the North Western Frontier had to encounter not only a large number of rivers and hill torrents, but also several hundred miles of undulating country broken up by big ravines and canyons and ending alongside the lofty Himalayas. In Rajputana and Sind, vast expanses of sandy desert, and the unavailability of water for several miles on stretch, provided problems of a different character.

To all these difficulties created by natural conditions was added the difficulty of obtaining trained labour and skilled technicians for engineering works of great magnitude and technical complexity.

WAR OF INDEPENDENCE

After the first lines had been opened railway development in India naturally followed the course of least resistance and maximum profits. There was, however, one other factor which held up railway development for a few years and which had nothing to do either with natural obstacles or with shortage of capital or skilled labour. By 1856 a variety of contributory causes had created considerable political unrest leading finally in 1857 to what historians have variously described as 'the War of Independence' or 'the Great Mutiny.' All railway building activity was held up during this disturbed period. It was in 1858 after the political control of India had passed from the East India Company to the Crown, and political conditions had fairly stabilised in the country, that the development of railways could again be taken in hand.

THE GHATS

The Great Indian Peninsula Railway Company after a careful survey of the Thal and Bhore Ghats had started work in 1856 to run a line from Kalyan over the Bhore Ghats to Poona and over the Thal Ghats to Bhusaval. The former route was to serve as a connecting link with South India and the latter with Delhi and Calcutta. The laying of the track over these two Ghats was an enterprise as difficult and expensive as had confronted engineers in any part of the world. In many ways it was a unique achievement in railway development. In 1861 the line was opened to Kasara, at the foot of the Thal Ghats and a year later, 21st April 1863, the Bhore Ghats incline was opened to railway traffic. The entire Thal Ghats route was completed in 1865.

While engineers and workmen were struggling to lay the track through the impregnable rocks and impenetrable jungles of the Thal and Bhore Ghats, the laying of the permanent way in districts beyond these rugged altitudes had proceeded space, with the result, that by the end of 1861 the line had been completed as far as Shivgaon to the north and Sholapur to the south. The three termini at Nagpur, 519 miles from Bombay, Raichur, 422 miles, and Jubbulpore, 615 miles, had been respectively reached and opened to traffic on 10th February 1867, 1st May 1871 and 7th March 1870. Great difficulties confronted the engineers during the construction of the Jubbulpore section, especially the 339 miles from Bhusaval to Jubbulpore, which consisted of a long stretch of undulating country and trackless jungles infested with wild animals. Here and there lay marshes, breeding some of the most deadly malarial mosquitos. Besides, there was the problem of building bridges over the Narbada and its tributaries, which not only during the rainy season reached unmanageable dimensions, but in terms of soil presented problems which made bridge building a difficult hazard.

THE EASTERN NETWORK

In the meantime, by 1860 the East Indian Railway had extended its line further from Pundooah to Rajmehal which was later to be known as the Sahibganj Loop. It took another two years to complete the loop line up to Kiul *via* Jamalpur, and by the end of 1862 this had been connected to Moghal Sarai. Work had also started in 1858 on the Allahabad—Aligarh line, the section up to Kanpur having been completed by 1859, and a further 87 miles up to Etawah being opened in 1860. By the beginning of 1862 the company had 243¾ miles of railway track in the North West Provinces, and 359½ miles in Bengal, the dividing line being the big rivers. In February 1863 Lord Elgin, the then Viceroy, travelled from Calcutta to Banaras and the following extract from the official gazette dated 7th February 1863, gives an idea of the progress made by the East Indian Railway till then:

> 'The distance from Calcutta by rail to Banaras is 541 miles. Work was begun in 1851. The line to Burdwan was opened in February 1855; to Adjai in October 1858; to Rajmehal in October 1859; to Bhagalpur in 1861; to Monghyr in February 1862 and to opposite Banaras in December 1862. In ten years, therefore, have been opened (including branches) a continuous length of 601 miles being at the rate of 60 miles a year. This is exclusive of the portion of the line already finished between Allahabad and Agra in the North West Provinces and of the section from Agra to Aligarh which it is expected will be ready in a few weeks. Including this length, the progress of the East Indian Railway has not been short of 90 miles a year.'

CALCUTTA TO DELHI

By 1863, other sections of the projected main line had been completed, but it was not until 1st August 1864 that the East Indian Railway could be opened up to

The Bengal Hurkaru and the India Gazette (Daily) Calcutta. 14-8-1854.

A TRIP FROM HOWRAH TO CHINSURAH BY RAIL.

Left the Howrah Station at 8-30 A. M., 11th August 1854.

Arrived at the Hooghly Station at 10-1 A. M.

Time occupied in running :—

Howrah to Bally, 5½ miles,............	11 minutes.
Bally to the Station at Serampore, 6¼ miles,............	14 minutes.
Station at Serampore, to ditto at Chandernagore, 8½ miles,.........	20 minutes.
Station at Chandernagore to ditto at Chinsurah, called in the Railway Time Table, the "Hooghly Station," 3 miles,.........	8 minutes.
Total time occupied in running from Howrah to the Station off Chinsurah, 23¼ miles,...... .. .. being at the rate of 26.32 miles per hour.	53 minutes.
Consumed in stoppages at the several Stations,............	38 minutes.
Total time consumed from Howrah to the Station at Chinsurah, including stoppages,.........	91 minutes.

Motion : Easy throughout, but Mr. Hodgson, the Chief Locomotive Superintendent, intimated that it would be more so after things have been working some time.

Behaviour of the Locomotive Superintendent and his Staff,—polite and attentive.

Impressions left by the trip,—the very best. This new mode of travelling will soon supersede every other in India, and all things considered, it is the cheapest,—it is cheap at any price in fact.

Accommodation : The present carriage is a temporary one, but roomy and comfortable.

As we passed along, the natives assembled on either side of the road, salaamed the furious *Salamandrine* in its course.

P. S.—There *must* be a Bridge from Calcutta to Howrah. The trouble and inconvenience of going over to avail oneself of the Rail is very great indeed, especially during wet weather when it is most disagreeable.

Above : A spectacular view of the ceremony at Burdwan of the opening of the East Indian Railway to Raniganj in 1855. (Reproduced by the courtesy of 'The Illustrated London News').

Below : Byculla Railway Station in 1854. (Reproduced by the courtesy of 'The Illustrated London News').

the banks of the River Jamuna at Delhi. The delay was largely due to a question having been raised as to the route the projected main line should follow. While work was proceeding apace for the construction of a large bridge over the Jamuna at Delhi, the Government of India proposed that the main line from Calcutta should proceed to Lahore *via* Meerut and Saharanpur instead of following the original route *via* Delhi and Ferozepur. In view of this, work on the Jamuna bridge had to be suspended, since under the new arrangement it was felt that it might be more desirable to complete 'the bridge as a road bridge into Delhi instead of a railway bridge.' After protracted discussions and delays it was finally decided that the East Indian Railway should run into Delhi, and that a separate Punjab line should be constructed *via* Meerut and Saharanpur, also connecting Delhi by a short section of twelve miles from Ghaziabad.

Mr Crawford, Chairman of the Board of Directors of the East Indian Railway Company in his address to the shareholders in April 1864, announced that 'it was a great gratification to him to state that the line from Calcutta to Delhi was open for traffic with the exception of the bridge over the Jamuna at Allahabad. They could now take passengers over their line from Calcutta to Delhi and *vice versa*, a distance of 1,020 miles.' A year later on 15th August 1865, the bridge over the Jamuna at Allahabad was opened to traffic. It had taken nearly eight years to construct, and was then considered an outstanding feat in bridge building in the East. In 1866 the Jamuna bridge at Delhi was opened to traffic. This was the last of the great bridges required to link the railway track from Howrah to Delhi. For the first time a passenger could now board the train from Howrah and 'proceed to the city of Delhi in the same carriage.'

BOMBAY—CALCUTTA LINK

During the same period the East Indian Railway was spreading westward. Work on the Jubbulpore line *via* Allahabad, had been proceeding to connect the East Indian Railway with the Great Indian Peninsula Railway extension from Bombay at this central point. The Allahabad-Jubbulpore line was completed in 1867 and was opened to traffic on the 1st of June of that year, furnishing a continuous link between Calcutta and Bombay. The official opening of the route connecting Calcutta, Allahabad, Jubbulpore and Bombay, however, took place on 7th March 1870. It was one of the most historic and spectacular functions in the early development of Indian Railways.

The ceremony was performed by the Viceroy, Lord Mayo with His Royal Highness the Duke of Edinburgh as Chief Guest. It was also attended by the Governor of Bombay, Sir Seymour Fitzgerald, the Governor of Bengal, several Indian Princes and their Ministers, and a large number of dignitaries from all parts of the country.

Lord Mayo's speech on this historic occasion outlined the great achievements of railway builders in India up to the time, and indicated the lines of development for the future. Declaring open the 1,300 miles of railway connecting 'this great peninsula between Calcutta and Bombay,' he stated that £22 million of capital expenditure had already been made on the railways in India, of which £2 million had been spent only on opening the track over the Thal and Bhore Ghats inclines. Four thousand miles of railway were approaching completion all over the country connecting Madras, Bombay, Calcutta, Delhi, and Lahore, at a cost per mile of something like £17,000. 'It was thought desirable that, if possible, at the earliest possible moment' concluded Lord Mayo, 'the whole country should be covered with a network of lines on a uniform system. The aggregate length of lines comprised by the whole scheme will be upwards of 15,000 miles. Of this 4,000 miles are at present open, 1,000 miles are in progress, and 900 are about to be immediately commenced.' The target of 15,000 miles was however reached much later. At the end of 1892, twenty-two years after the ceremony at Jubbulpore, the total route mileage did not exceed 18,000. Even then taking the period from 1850 to 1892, new lines had been opened at an average of 430 miles a year, with an average annual expenditure from all sources of about Rs 557 lakhs. This compared very favourably with railway development in most of the countries of the world and Romesh Chandra Dutt even critically remarked that the Indian Railway System 'was more extensive in mileage than all the countries outside Europe and America, and even ahead of many countries of Europe.'

RAPID GROWTH

After 1870 railway development was rapid. The Bombay, Baroda and Central India Railway extended its lines in western India. By 1861, the Madras Railway Company had extended the line from Madras to Kadalundi connecting it in 1871 with Raichur the junction on the Madras—Bombay route. The Bengal Nagpur Railway started operating in 1863, and it was on 3rd March 1891 that its 600 miles of broad gauge line was thrown open to traffic.

The Bombay, Baroda and Central India Railway came into existence in 1860. Partly by its own lines and partly by acquiring lines run by Indian States or built in co-operation with them, it opened up two new direct routes to Delhi, one *via* Surat, Baroda and Ratlam and the other *via* Ahmedabad and Ajmer through Rajputana. In the latter case the line ran on a metre gauge from Ahmedabad to Delhi. The Rajputana-Malwa metre gauge system constructed in 1870, originally a government railway, was leased to the company in 1885. Serving as feeders to the Bombay, Baroda and Central India Railway system the Kathiawar, Indian States Railways consisting of the Bhavanagar State Railway, the Gondal Railway, the Baroda State Railway, the Jamnagar Dwarka Railway, the Junagadh State

Railway and the Morvi Railway constituted a network in Kathiawar, now known as Saurashtra.

The North Western Railway had by 1892 extended the main line up to the North West Frontier Province, and had constructed a total of 2,000 miles of branch and feeder lines to serve the rich agricultural districts of the north. The Southern Mahratta Railway in the Deccan was by this time operating more than 1,000 miles of railway, while the railways in the Rajputana-Malwa section run by some of the Indian States, covered more than 1,700 miles.

The Nizam State Railway which had started in 1870 opened for traffic the first section from Wadi to Secunderabad on 9th October 1874. For four years this section was worked by the Great Indian Peninsula Railway and then up to 1884 by the Hyderabad State Railway Agency. Later the Nizam's Guaranteed State Railways Company was formed under a contract dated 27th December 1883 and took over the section. By 1890 the Company had nearly 320 miles of railway being the largest railway system run by an Indian State.

Burma was part of India until its separation in 1937. The development of the Burma Railways up to the time of separation forms part of the history of Indian Railways. The Burma State Railway, the first line in the Irrawaddy section, was opened on 1st May 1877, from Rangoon to Prome, a distance of 167 miles. In 1896 the Burma Railways Company was formed for taking over the working of the original system and extending it by the construction of other lines, particularly one from Mandalay to Kunlong.

During this period and in the succeeding years, besides the construction by major Companies operating on the main routes, construction continued both by direct State Agency, *e.g.* in Tirhut, as also by Indian States like the Gwalior, Bikaner and Jodhpur State Railways, and private enterprises like the Bengal and North Western Railway Company, Assam Bengal Railway Company, etc. By the end of March 1922 India had 37,266 miles of open railways, which increased in 1938-9 to 41,153·76 miles. During the war some of the lines were dismantled and on the eve of Independence India had 40,524 miles of railways. Some parts of the track went to East and West Pakistan in 1947, and a few lines were subsequently added. Today Indian Railways have a total route mileage of 34,000 miles, being still the third longest system in the world.

III. Growth of Companies

THE GROSS ANNUAL REVENUE of the Central Government for 1951-52 was Rs 497·67 crores. The gross revenue of the Indian Railways for the same year was Rs 294 crores, being nearly three-fifths of the total revenue of the Central Government. The railways spent Rs 228 crores during the year. The expenditure of the Central Government for all departments of the administration was Rs 405·06 crores. These are impressive figures, and convey to some extent the financial magnitude of the railways as an undertaking. The entire railway system today is controlled, run and financed by the Central Government with the exception of some very minor light railways. The Indian Railways constitute one of the largest, if not the largest, nationalised enterprises in the world.

All the major railway systems of India and quite a number of the minor ones, were originally started by private companies with capital almost wholly subscribed by shareholders in Britain. A few of the lines were run by the Indian States. In 1843, when the earliest proposals for constructing railways in India were put forward, England was passing through a period of 'railway mania.' Railway shares were the talk of every middle class home and Lombard street. Financiers having found railways in their own country a profitable means of investment eagerly looked forward to making similar profits 'in other parts of the world.'

BRITISH INVESTORS

'Between 1839 and 1841,' writes Cyril Bruyn Andrews, 'money like bread was dear, following its dissipation in the first railway boom, but by 1843-44 money had become plentiful and abnormally cheap. The early railways began to pay, and the real railway mania started. England began to find money, not only for British but for foreign rails.' Railway shares were heavily in demand by speculators and investors spread over almost every section of society in Britain. A list of these 'speculators' or 'investors,' with their functions compiled by an Order of the House of Commons, contains: 'peers and printers, vicars and vice-admirals, spinsters and half-pays.

The following appeared in one of the British papers at the time as descriptive of the railway mania:

> ' Old men and young, the famish'd and the full,
> The rich and poor widow, and wife, and maid,
> Master and servant — all, with one intent,
> Rushed on the paper scrip ; their eager eyes
> Flashing a fierce unconquerable greed ——
> Their hot palms itching — all their being fill'd
> With one desire.'

Early in 1845 a formally drawn up prospectus was put before the Court of Directors of the East India Company, which proposed to raise a capital of one million sterling, for the construction of an ' experimental ' railway starting from Calcutta and extending for 140 miles towards Allahabad.

The East Indian Railway Company asked at the outset for a guarantee on its outlay, of three per cent, but were willing to be content with a bonus of £30,000 per annum ' in order to encourage the introduction of railways into India.' Within a year the Great Indian Peninsula Railway Company was formed with the ' object of constructing a railway line from Bombay towards Delhi, Calcutta and Madras.'

At this very time the authorities in India started seriously to consider, firstly, whether conditions in India at the time made railway construction practicable, whether railways, if started, would be profitable undertakings, and, lastly, if railways had to be started whether it should be by the Government or by private enterprises, and if the latter, what help could be given to such enterprises by the Government.

In the United Kingdom the railways had required but little more than guidance from the State and Parliament. Railway enterprises had sprung up with marvellous rapidity into popularity and power. The people had adapted themselves to railway travel and railways had become the cheapest and the most popular means of transport. In India it was argued the position was widely different. It was thought then that railways in India may possibly get ' a fair share of the goods traffic but next to nothing in the shape of passengers.'

After many discussions and much deliberation the Court of Directors addressed a despatch on the subject to the Governor-General on 7th May 1845, which is the first official document on record, to explore the desirability and the practicability of starting railways in India. Shortly after sending this despatch the Court of Directors sent an experienced railway engineer Mr F. W. Simms who arrived in September 1845, and submitted a memorandum on 6th February 1846, along with a report of the committee of engineers suggesting that railways in India ' with proper attention can be constructed and maintained as perfectly as in any part of Europe.'

EARLY PROPOSALS

He made several suggestions as to the terms which should be offered to British capitalists to start railroads in India. He proposed that a ' lease ' should be given to a company affording it the power to construct, maintain, and ' hold ' certain lines for a specified term of years; that land should be given by Government free of cost for the permanent works; that no tax should be imposed on the railway as it proceeds; that the company should make the necessary surveys and plans and submit them for approval, that the company should construct lines in accordance with an approved specification, and maintain all works in perfect repair, until the expiration of the lease, and that on expiration they should be handed over to Government without payment. The failure to run one train a day from end to end of a line was to be held to be evidence that the railway had ceased to be employed as such. All Indian Railways were to be constructed on one specification, worked on one system, and supplied with stock of one uniform pattern. Mr Simms further suggested that the Government might, in addition, ' think it advisable to guarantee a small percentage upon the actual cost of works, which guarantee should not operate until the railway was open for traffic, and should cease if a line was not worked regularly or satisfactorily.'

In replying to the despatch of the Directors and in dealing with the report of the engineers and the suggestions made by Mr Simms, the Government of India, then under Lord Hardinge, considered that the proposal to give land free of cost ' was right and proper.' This concession which was subsequently adopted has been a common feature of all railway concessions granted to private companies. This was not only a great and generous concession, but it also removed one of the serious difficulties which had stood in the way of rapid railway expansion in England. The railways in England were not only not given land by the Government free of charge, but had actually to fight for it for several years, till in 1825 Parliament enacted a law whereby a private owner of land could be compelled to sell that part of his land which was considered essential for the construction and running of a railroad. Such was the extent of opposition by landholders that the Bill, at an earlier stage was rejected by a majority of the House of Commons and had to be re-introduced for a second time before it was adopted.

The Government of India decided to retain the power of eventually becoming the proprietors of railways in India. This became a leading feature of all subsequent contracts. The guarantee of a grant, or interest, was considered impolitic, and it was argued that ' if the Government gave land free of cost it should be sufficient evidence of the active part it proposed to take in promoting such schemes.' The Government of India assessed the value of land at £200 per mile.

In forwarding the views of the Government of India the Governor-General, Lord Hardinge, in a separate personal minute laid stress 'on the great military advantages which railways would afford, in addition to their most obvious benefits commercially and socially,' and concluded by recommending a grant of one million sterling or an annual contribution of Rs 5,00,000 (then worth £50,000) to the railway completed between Calcutta and Delhi. The Court dissented from the Government of India, but agreed with Lord Hardinge and held a guarantee to be essential for encouraging private companies. The Court recommended four per cent on all sums paid into the treasury up to a certain figure representing a cost per mile of £15,000. On 19th December 1846, the Board of Control communicating its views to the Court of Directors accepted the proposal for constructing railways by means of companies, modified the terms for ultimate purchase, but objected strongly and entirely to the idea of guarantee, 'or at least until the Directors of the East India Company were fully satisfied that the money could not be raised without it, and then only for a period of 15 years.' These terms were not acceptable to the promoters but the Board of Control would not yield.

This was the time when the 'railway mania' in England had turned into a 'nine-day wonder.' The share market was in a state of slump, investors had lost heavily on railway shares and capital had become railway shy. The feelings of the middle class investors in railway shares can be gauged from what the *Railway Gazette* of London wrote at the time. It said:

> 'We attack, and we have attacked, only the notorious abuses of the stock market. We point out facts ; we expose fraud ; we invite inquiry, and invoke justice. Any one who can feel angry at our proceedings, must either have a sympathy for rascals, or have practised the rascality which we have denounced. We say, the men who perverted—if you will — the Stock Exchange system of business, so as openly to 'rig' bubble schemes, concocted to rob the public, up to bubble premiums, and who received large bribes for so openly rigging the market, ought to be reached by our criminal law, or failing this, to be expelled from the Stock Exchange.'

THE FIVE PER CENT GUARANTEE

In 1847 the Board of Control 'reluctantly conceded, in view of the then condition of the money market' to raise the rate of guaranteed interest from four to five per cent for a period of 25 years. Later, on 17th August 1849, on a further representation being made to them by the Board of Control, the Court of Directors decided in favour of an absolute five per cent guarantee without limitation of time. Under this system of guarantee and control the major trunk lines of India were constructed—the East Indian, the Great Indian Peninsula, the Madras, the Bombay, Baroda and Central India, the Sind, Punjab and Delhi.

Public opinion both in India and in England, official as well as non-official, was highly critical of what were characterised as unduly generous terms given to the British investors at the expense of Indian taxpayers.

'Railway operations were commenced in India under an arrangement, calculated to lead to extravagance, and not calculated to secure the comfort of passengers,' wrote Romesh Chandra Dutt, summing up the Indian view-point against the guarantee system. 'Private companies working under a State guarantee of profits at five per cent or four and a half per cent on the outlay,' he said, 'were not likely to observe economy in the outlay, or to seek the convenience of travellers. If there was extravagance and waste in construction, the shareholders nevertheless, got their guaranteed profit on all the money that was spent, wisely or unwisely. If traffic decreased and the earnings fell short of the guaranteed rate, the difference was made good from the revenues of India, that is, from taxes paid by the people.' The evidence tendered by some of the experts and high ranking British officials before Parliamentary committees set up for investigating the conditions of Indian Railways during the years 1871-74 supported this criticism.

William Thornton, a very important witness, who was examined by the Parliamentary committee in March 1872 held that 'the guarantee system has not served any purpose whatsoever which might not have been served without it.' He asserted, 'I think that the contracts are a perfect disgrace whoever drew them up . . . the undertakers of the railway, the company, are deprived of one of the great inducements to economy. They know that whatever blunders they make, those blunders will not prevent their getting full current interest on their expenditure.'

The Right Honourable William N. Massey who had been Finance Minister of India under Lords Lawrence and Mayo considered that the East Indian Railway Company had cost twice as much as it ought to have cost since 'all the money came from the English capitalists, and so long as he was guaranteed five per cent from the revenues of India, it was immaterial to him whether the funds that he lent were thrown into the Hooghly or converted into brick and mortar.' Sir John Lawrence, a former Viceroy of India, appearing before the Parliamentary Committee in 1873 said, 'I think it is notorious in India among almost every class that I ever heard talk on the subject, that the railways have been extravagantly made; that they cost a great deal more than they are worth, or ought to have cost.' In an earlier minute dated 16th August 1867, Lord Lawrence as Viceroy had estimated that while the companies will have to supply 81 million (pounds) for the railways now under construction, the Government contribution will be seven and a half million for land, loss by exchange and supervision; 14½ million for interest paid in excess of net revenue; and four and a half million in interest paid on the payments of guaranteed interest.

According to an official report submitted to the House of Commons in 1872-73, 'the whole amount of guaranteed capital that had been raised up to March 31st was £94,725,000 of which £92,417,000 has been expended. The sum expended directly by the Government amounted to £5,398,000 making a total expenditure of upwards of £100 millions.' The report added: 'There are now open in India 5,872 miles of railway which should cost about £97 million, giving an average expenditure of £16,536 per mile. The exorbitance of the expenditure becomes evident when it is realised that in Australia, the cost per mile for railway construction was £12,000 and in Canada only £8,500.'

A CHANGE IN POLICY

In July 1869 the then Secretary of State, the Duke of Argyll, laid down that 'both in raising capital and expenditure that may be required for the new lines in India, the Government should secure for itself the full benefit of the credit which it lends, and of the cheaper agencies at its command.' The Contracts with the guaranteed lines empowered the Government to acquire them on certain terms after the first 25 years after giving six months notice.

Main line companies started on the guarantee system were thus purchased by the State as and when their contracts expired. By 1907, with the exception of the Bengal and North Western Railway, and the Rohilkund and Kumaon Railway Companies, all the main lines became the property of the State. But in almost all cases after formal purchase, fresh arrangements were arrived at with the companies to run the railways on behalf of the State, an arrangement, which by later experience was found to be as seriously open to objection as the earlier system of guarantees. A typical example of this arrangement is the East Indian Railway Company which was purchased in 1879. The purchase price was to be paid by means of annuities terminable in 1953. At the same time the shareholders who were entitled to one-fifth of the amount of annuities, that is £ 6,550,000 having agreed to postpone their annuities, accepted a new contract in return. The Deferred-annuities shareholders, as they were called, undertook the management of the railway and were guaranteed in return four per cent of the capital as also a share in surplus profits.

The extent to which the State and the taxpayer lost in these transactions is illustrated by the very material gain which accrued to the shareholders and the companies. The figures for 1891-92 of the Great Indian Peninsula and the Bombay and Baroda Railways show that the share of surplus profits of the shareholders of the former, in that year, was Rs 51,87,260 and of the latter Rs 17,98,260, 'besides contributions to provident fund.' The shareholders made a further substantial gain in terms of the exchange ratio. According to the contract the interest paid in England was to be converted into Indian currency at the rate of exchange,

namely 1s 10d to the rupee, while at the time of payment the rate of exchange had become considerably lower.

WAR AND FAMINE

Apart from the main trunk lines, between the year 1872 and 1890, a large number of branch and feeder lines were developed for protective, commercial and strategic purposes. During the five years 1874-79 India was visited by a succession of serious famines which resulted in appalling loss of life. The famines were most widespread in Madras, Bombay and Mysore, and according to official figures 'resulted in the death of more than four million people.' A picture of the terrible losses suffered by the people during these famines was given in a paper read by Sir Theodore Hope before the Society of Arts in England in 1890. 'These figures' he said, 'do but imperfectly indicate the loss of the people, whose savings of years were depleted, whose cattle died in enormous number, whose enfeebled condition rendered them an easy prey to a whole army of fatal diseases, even after actual famine had ceased, and among whom the normal birth-rate could not have recovered for some years.'

There were two directions in which protection was obviously needed against such calamities. One was the construction of irrigation works, and the other, and more pressing, the extension of the means of communication by which the surplus produce of one area could be rapidly and readily diverted to that in which famine was impending. The Famine Commission appointed in 1880, insisted on the great importance of railways for the prevention of famine and considered 'that 5,000 miles of line were urgently needed, and that the country could not be held to be safe from such calamities in the future until the Indian railway system could show an aggregate of 20,000 miles.'

The Afghan War led the then Government to consider the need for extension in yet another direction, namely, the opening up of lines for purely strategic purposes as conceived by them. After the conclusion of the Afghan War the Government of Lord Ripon gave serious consideration to the steps that were required to be taken to open strategic lines on the one hand, and to implement the recommendations of the Famine Commission on the other. While past experience had shown that the more efficient and economic method for constructing railways in India was the agency of the State, those in authority in India and in England, after prolonged correspondence came to the conclusion that the Government could not secure, by borrowing or otherwise, all the amount that was required for carrying out its plans, and that it was necessary, even though it be on new terms to enlist the co-operation of private agencies. It was finally decided that while new productive and profitable lines should be left entirely to private commercial undertakings, 'the Government should only undertake the construction of railways

which through their unprofitable character in a commercial sense, or other causes, cannot be made by private agencies.'

Thus in the eighties started an era of company lines, side by side with State lines 'both in construction and administration.' It was hoped at first that railways without a guarantee, or at least on a guarantee for a limited number of years. which appeared likely to be remunerative would be taken up by companies either Early in 1882 the Southern Mahratta Railway Company was formed. The Company was expected to supply the capital, and arrange and operate the railway which in all other respects belonged to the State. A guarantee of four per cent was given on the capital for seven years, and three and a half per cent subsequently, together with a one-fourth share to the Company on net profits. Later in the same year another company, the Bengal and North Western, was launched without a guarantee; the share of profits over six per cent being only reserved for Government.

The year 1885-87 witnessed the launching of two important lines—the Bengal Nagpur and the Indian Midland—on conditions similar to the Southern Mahratta Company, but with Government offering a permanent guarantee of four per cent, and one-fourth of surplus profits. This arrangement in essence was a reversion to the policy of Lord Dalhousie, the main differences being that the rate of interest was four instead of five per cent, the major share of profits over the guaranteed figure was taken by the State, and each line was held to be State property from the outset.

The State undertook exclusively the work of building strategic railways required for military and defence purposes. In his famous minute of 1853 outlining railway policy in India, Lord Dalhousie had discussed the importance of the railway system, for military purposes. But up to the outbreak of the Afghan War at the end of 1878 no practical steps were taken in this direction. The Afghan campaign revealed the need not only for improved means of moving troops to and along the frontier, but for improvement in the carrying capacity of existing lines leading from the chief cantonments. The value of railway communication in this campaign was vividly illustrated by the railway which had then been rapidly constructed to the mouth of the Bolan Pass. 'One train in a day of 16 hours,' according to an official account, 'was found to do the work which it would have required 2,500 camels to do in a fortnight.' During the Viceroyalty of Lord Ripon a definite programme for strategic railways, which was estimated to cost over five million sterling, was outlined, and it was decided that this outlay should be derived from borrowed funds.

Lord Ripon's Government, at the same time, seriously objected to the starting of new companies on the guarantee system, and insisted that either the new works should be undertaken by the State by borrowing money in England, or should be

entrusted to private companies without a guarantee, the only concession being free land. Outlining its views in the course of a despatch in 1887, the Government of India recorded:

> 'The ideal of private enterprise in Indian Railways in the views of the Government of India, was that a company should require nothing more than a free grant of land ; but they were not prepared to start the creation of companies which would have a very limited interest in the concern from which they took their name, which would contribute only a small portion of the capital at an unnecessarily high rate of interest, on what is really absolute security, and which, for the rest of their capital, would have to take from the Government Treasury, funds in the management of which the State should thereafter have but little influence, and for which it would probably get a very poor return.'

NEW TERMS

In pursuance of this policy an agreement was signed in 1889 with the Delhi-Ambala-Kalka Railway Company by which the latter was to construct a line in conjunction with the East Indian Railway with the grant of free land only; but on condition that on the completion of the railway the line should be worked by the State for 50 per cent of the gross receipts. In November 1890 the South Indian Railway Company whose original contract had expired was offered a new contract whereby the Company was to work and manage the existing lines, and to raise as capital one million sterling for the purpose of extensions. The interest on this at three and a half per cent for three years, and thereafter at three per cent, was to be first charge on the net revenues of the line. The second charge was to be the interest at three per cent on the Government share, that is, the original cost of the line. The surplus over and above these charges was to be divided in proportion to the capital subscribed by the Government and the Company.

Up to this stage, railway development had passed three distinct phases of policy. From the beginning up to 1869, the construction and working of railways was left entirely to companies with some form of guarantee. From 1870 to 1880 all new lines were constructed by the direct agency of the State and with State funds. From then onwards and up to 1907 the operations of both the State and aided companies went on side by side. During this phase productive lines were leased to private enterprises, while the unproductive lines were started by the State, either directly or indirectly.

From 1907 onwards, after all the major lines had been purchased by Government and leased for purposes of management to private companies, the companies operating railways in India could no longer be characterised as private enterprises in the true sense of the term. Their interest in the undertakings was not comparable to that of ordinary joint stock enterprises. With a nominal capital

outlay and guaranteed interest thereon, they were only managing agencies working the lines for the Government of India. In 1920, the Government of India owned 73 per cent of the total mileage of the country. If the lines owned by the Indian States are excluded, private companies accounted for only 15 per cent of the total mileage of 37,029. In spite of this predominant State proprietorship, the Government operated only 21 per cent of the railway system, while the companies managed and operated 70 per cent. These arrangements continued to be the subject of strong public criticism in India, and even in England.

PROTEST AND OPPOSITION

As early as 1910, speaking in the Imperial Legislative Council, the great Indian Liberal, Gopal Krishna Gokhale, urged in forceful language that the railways should be managed by the State, claiming that state management would be more economical. Mr Gokhale said:

> 'You compare the ordinary public work list—the personnel of the public work offices with the personnel of railway offices—throughout you will find practical exclusion of Indians from the higher ranks of the railway services. Whereas in the Public Works Department a considerable portion consists of Indians, in the railway service it is only here and there that you find an Indian. For the most part Indians are carefully shut out. Now if all these railways were managed by the Government, the Government would in the first place be more sympathetic to our aspirations than the Board sitting in London, and secondly, the Government would be more responsive to any pressure of opinion put upon it. The Board being in London, we may say what we like, they go on doing what they please and the Agents here must obey their Directors there. Therefore, as long as the management is in the hands of companies the exclusion of Indians from higher ranks of the railway service must continue, whereas if the management were to be passed over to the Government, there would be more state employment of Indians in the higher ranks of the services, and this, in due course, is bound to lead to greater economy in the management of the railways.'

During World War I, the position became worse. Not only was a heavy strain placed on the railways by the transportation of troops and war material at high priorities, but India was called upon to meet heavy demands for staff and material for railways in East Africa and elsewhere. Up to 31st March 1916, foreign expeditionary forces had been supplied with 50 locomotives, 600 vehicles, 165 miles of rails and fastenings and half a million sleepers. Large quantities of stores and tools and plants of all kinds necessary for the construction, repair and working of railways were also requisitioned for military purposes in East Africa, Mesopotamia, etc. Railway workshops were made to divert their resources to the production of high explosive shells, hospital trains and other war equipment. Indian Railways emerged from the war in a battered and dilapidated condition. Rolling-stock and other operational equipment were in a state of disrepair. The

railways were short of stock and many locomotives had long passed the age of superannuation. Workshops were so overcrowded as to be incapable of handling increased repairs. Speeds were reduced owing to the worn-out track and ageing locomotives. All this naturally led to the restriction of passenger services, congestion in trains, serious curtailment in the carrying of goods and commodities, unjustifiable economies in maintenance, repair and amenities, leading to wider and deeper public discontent and dissatisfaction.

One other reason which at this stage lent irresistable strength and force to the popular demand for a thorough reconsideration of railway policy, and a complete overhaul of the system of railway management, was the fact that in 1919 the contract of the East Indian Railway Company was to expire. The contracts of some of the other companies were due to expire a few years later. Notice had already been given in 1917 by the Secretary of State for the termination of the contract with the East Indian Railway Company, but Government had still not made up their minds as to whether the State should assume control of this and other railways, or transfer the same to companies as and when the contracts expired.

Indian public opinion as represented in the Imperial Legislative Council had unanimously urged in repeated resolutions moved in 1914, 1915, 1917 and 1918, the appointment of a committee to enquire into the desirability of adopting direct state management. In response to this demand the East India Railway Committee (1920-21), with Sir William Acworth as Chairman was appointed in November 1920 to go into the whole question of railway policy, financial and administrative.

> 'to recommend suitable methods of management, to examine the functions, status and constitution of the Railway Board and the system of Government control over the Railway administration, to consider arrangements for the financing of railways in India, and to make such other recommendations that may seem germane to the enquiry.'

IV. Towards Nationalisation

THE ACWORTH COMMITTEE by its recommendations laid the foundations of State management and State control of Indian Railways. It set up the broad structure of a centralised railway administration and rationalised, in accordance with accepted economic and commercial principles, the entire system of railway financing. Its recommendations, constituted the broad basis on which the railway system in India developed in subsequent years.

The Acworth Committee consisted of ten members, of whom three, namely, Mr V. S. Srinivasa Sastri, then Member of the Council of State, Sir Purshotamdas Thakurdas, representing 'Indian commercial interests' and Sir Rajendra Nath Mookerjee, an outstanding industrialist of Calcutta, were Indians.

On the crucial point of the State taking over the control of railways 'which it owned,' it was not possible for the Committee to make a unanimous recommendation. As many as five members of the Committee, being half of the total membership, including one Indian member, Sir R. N. Mookerjee, expressed their strong opposition to the recommendation of the Chairman and his four colleagues in favour of State control and State management. The Committee, however, unanimously agreed 'that the English companies shall be brought to an end on the broad ground that they represented a system essentially unworkable,' and 'that the property entrusted to their management is not their own and their financial stake in the undertaking is relatively very small.' 'A large section of Indian public opinion supports the adoption of this system (State management),' remarked the Committee 'because they believe that company management does not encourage the development of indigenous industries by sufficiently favourable treatment; that it gives preferential treatment to import and export goods, that under the present system of company management large profits are made by British interests; and that hitherto the companies have not employed Indians in higher appointments, except to a very limited extent, and have not granted them adequate facilities for technical training.' 'There is also in addition,' averred the members, 'a positive feeling caused by an awakened national self-consciousness

that Indians should have more control of the management of the railways in their own country.' While this summed up fairly correctly the extent and the causes of Indian opposition to the existing method of company management, some members felt that the alternative recommended by them of Indian 'domiciled' companies would be more acceptable to Indian opinion.

WORLD EXPERIENCE

According to witnesses who appeared before the Committee, except in the case of America, where even railways set up originally by the State, were transferred to the control of private companies, the experience of virtually every other country had shown that State ownership and State management was by far the best method of running and developing the railway system. Before 1930, the Reichbahn operated 53,700 kilometres of lines while private railways accounted for only 4,700 kilometres. Under the Weimar Constitution the entire German railway system came under State control. In Japan, where railway construction had made tremendous advance the State repurchased in 1905 the greater part of the railway lines from private operators, and in 1932, 15,000 kilometres were owned and operated by the State and only 7,100 by private companies. In Russia, railways were originally developed by as many as 53 private companies started in the late seventies, but in due course a greater part of the Russian railway system came under State control, till after World War I the railways were completely nationalised. In Canada, Australia and other British Dominions, railways were being run by the State.

> 'We attach great importance to the fact that Indian public opinion is against company management' wrote the Chairman and his four colleagues in their separate minute, 'and this not only on the general ground that Indian opinion is entitled to great weight on a question such as this, but for another reason of great practical importance. It is by money secured from the Indian taxpayer that the Indian Railways have been almost entirely built. It is the Indian public that uses the railways and pays the railway rates and fares. It is the Legislative Assembly at Delhi which under the new constitution votes the Railway Budget. It is of the utmost importance that Indian public opinion should not be prejudiced against the railway management.' Concluding they said, 'Conditions in India being what they are, we have failed to find any solution of the problem submitted to us consistent with the retention of company management. We, therefore, do not hesitate, though most of us have approached the question with a strong prepossession in favour of private enterprise as a general proposition, to recommend that in India the State should manage directly the railways which it already owns.'

STATE CONTROL

The Chairman and his four colleagues having pronounced an unequivocal verdict in favour of State management, the Committee was faced with the problem as to

whether State control should be centralised in a single central authority or several separate autonomous authorities. There were many at the time in England and in India, among them the distinguished Sir M. Visvesvaraya, an engineer of great repute and authority, who urged that railway management should be decentralised and placed under the control of the several provinces. The view was further pressed on the committee that '37,000 miles of railway, spread over a country so large and so diversified cannot be managed from Delhi.' These arguments did not impress the committee. 'If there is one thing that railway history teaches more than any other,' recorded the Committee, 'it is that centripetal forces are stronger than centrifugal; that segregation into ever larger units promotes efficiency and economy.' In support of this they referred to Great Britain where railways had been combined into four groups, to France where a Bill was pending at the time bringing all railways into a single system, and to Germany, where it had been decided to transfer the control of all state railways to the Central Government and to work them as a single system. As regards mileage the Committee pointed out that the mileage of unified German Railways was considerably more, and their traffic immensely greater, than of the railways in India. They gave the example of the Canadian Pacific Railway which stretched across the continent and the Canadian National Railways which extended from the Atlantic to the Pacific and were managed in each case from a single centre, namely, Montreal and Toronto respectively. The Committee therefore, recommended that while there should be a considerable measure of executive decentralisation in the administration of railways 'the management and control should finally rest with one central authority.'

Having decided in favour of State management and one central authority, it was necessary to lay down the structure of that central authority, its relationship with the State, and to outline ways and means for financing fresh schemes of railways expansion, and rehabilitation.

CENTRAL RAILWAY AUTHORITY

The administrative position existing at the time was as follows:

> 'The Secretary of State representing the House of Commons was the ultimate authority for the governance of India. He delegated to the Governor-General in Council certain powers, reserving to himself others. The Government of India in turn delegated some portion of these powers to the Railway Board. Within the scope of these powers, the Railway Board were free to act, subject always to the approval of the Finance Department. The Railway Board at the time consisted of three members, the President having the responsibilities and the rights equal to those of a Secretary to Government. In certain spheres the President was supreme 'and the decision of the Board was, in fact, his decision,' while in ordinary matters the Board acted jointly and took majority decisions permitting the dissenting member to append a minute explaining his position.'

The Committee considered this a very defective arrangement.

> 'The Railway Board is in effect in the position of a step-child,' remarked the Committee, 'and like most step-children, tends to be less well treated than the other children of the family. We are convinced that the Indian Railways will never be able to give a satisfactory account of themselves, to earn the revenue which they should earn, and to render to the public the service which they ought to render, until they are represented in the Viceroy's Council by a member who is in touch with their daily work.'

While they were inclined to suggest the appointment of a Member of Council solely for Railways, the Government of India finally delegated this work to the Member of Council in charge of Commerce.

The position, powers and functions of the Railway Board itself according to the Committee required a complete overhaul. In doing so the fact had to be borne in mind that the Government Railways at the time were bringing in one-third of the total Government receipts. Their working expenses amounted to about one quarter of the total Government expenditure. Their net receipts covered not only the interest on the total railway debt incurred by the Indian Government, and a substantial contribution to the sinking funds, but a substantial sum in relief of general taxation. Apart from having to manage operations involving such large amounts of money, some idea of the work entrusted to the Railway Board could be obtained from the fact that during one year alone 71,000 communications 'were issued from or were received by the Board's office.' The work at headquarters according to the Committee, laid upon the shoulders of the Board 'a burden of routine work which is more than three men can cope with,' and it was natural that complaints should have been made to the Committee 'in different parts of India that the members of the Railway Board seldom or never visited them.' The Committee felt that the proper function of the Railway Board was not to carry out routine duties, 'but to shape policy, to watch, to think and to plan.' The Committee, therefore, recommended the appointment under the Member of Council for Communications of an enlarged Board consisting of a Chief Commissioner as head of the Board, assisted by four Commissioners, a Financial Commissioner and three Railway Commissioners in charge of Western, Eastern and Southern Divisions. Under the Board were to be six Directors being in charge of Accounts, Civil Engineering, Mechanical Engineering, Traffic Operating, Traffic Commercial, and Inland Navigation and Road Transport. The Board was also to have a General Secretary, and a separate Statistical Department.

AUTONOMY AND CONTROL

The Committee desired that the new central railway authority should be fairly autonomous, that it should prepare its own programme of work and expenditure and within the limits of its budget, as approved by the Government of India and

the Secretary of State, and accepted by the Legislative Assembly, should carry it into effect. In other words ' though remaining an integral part of the Government machine, and subject to control on broad questions of policy and the major question of finance on which policy must depend, it will be an independent administration.'

In respect of its relations with the management of various railways, whether they were state-managed or company-managed, it was recommended that the control in matters of details be released as much as possible, and the heads of the railways be afforded greater amount of freedom in incurring routine expenditure or in dealing with the staff.

It was not only in the sphere of administration that the Committee recommended greater amount of autonomy. In the realm of finance also, the Committee introduced a new emphasis on the commercial character of the railway undertaking, and the importance of operating railways on business principles. The Committee was of the view that most of the defects and shortcomings attributed to the Indian Railway system were due primarily to the failure of Government to provide railways with adequate funds for capital expenditure on development and extensions, and even for essential operations, renewals and repairs. ' They are,' observed the Committee, ' inevitable results of a system which has not been adapted and developed to meet the requirements of what is essentially a commercial enterprise of the first magnitude.' The railways, as Mr (later Sir) Clement Hindley, then Agent of the East Indian Railway remarked, had ' muddled through ' and Indian opinion was unanimous in demanding ' complete separation of the Railway Budget, in respect both of capital and revenue, from the General Budget of the country.' Under the existing system of budgeting, earnings from railways became part of the central revenues. Unlike other sources of revenue, railway earnings showed considerable fluctuation from year to year. The Mackay Committee had recommended in 1907 that Government should fix periodically a standard of actual capital expenditure which they might reasonably hope to maintain even in times of difficulty. In actual practice, this had not been done. What had happened was that in years of bad harvest and bad trade the Finance Members in trying to plan the general budget, and finding themselves unable to meet the imperative current demands of administration had drastically axed appropriations to railways, for renewals and departmental works and for necessary extensions and developments, ' even though they may be in the process of execution.'

> ' The effect of this policy of inadequate allotment,' remarked the Committee ; ' barring any regular up and down from year to year, would have been bad in any case, but it is made worse, since as not infrequently happens, the allotment is suddenly cut down during the currency of the year to which it relates, and works

> in progress are suspended, staff are disbanded on a moment's notice, and materials are left lying on the ground for an indefinite period. An almost equally bad effect is produced when later on in the year, the general financial position having unexpectedly improved, the Finance Member with equal suddenness lifts his hand and thus encourages the railways to spend more freely.'

The history of the Itarsi Nagpur Railway was quoted as a typical example of this policy. The line having a length of 238 miles and presenting no serious engineering difficulties had been started in 1908, but had not been completed till 1925.

A SEPARATE BUDGET

The Committee felt that the railways had continued to earn during the previous 20 years enough money to meet their ordinary requirements and had the Railway Budget been separate from the General Budget, 'there would have been no difficulty in providing all the money the railways needed to keep up to their programme of growth and development.' The Committee found it 'impossible to say' as to how much the economic development of India had suffered not from hesitation to provide for the future 'but from the utter failure even to keep abreast of the day-to-day requirements of the traffic actually in sight and clamouring to be carried.' 'We cannot think,' the Committee concluded, 'that even the war is sufficient to explain the treatment of Indian railway revenues in the last few years.' The Committee, therefore, recommended that the railways in future should have a separate budget of their own and assume the responsibility for earning and expending their own income. The first charge on the income, after paying working expenses, should be interest on the debt incurred by the state for railway purposes. After it has met this liability and 'subject to the general control of Government,' the railway department 'should itself regulate the disposal of the balance, and it should be free to devote it to new capital purposes or to reserves or to dissipate it in the form either of reduction of rates or improvement of services.' Even as early as 1899 during the Viceroyalty of Lord Curzon, several proposals were made for separation of railway revenues from general revenues but were not implemented. This recommendation of the Committee was, therefore, not a new one but was obviously an old proposal which had taken 20 years before it could be implemented.

The proposed step was also not of an exceptional character. When Bismark nationalised the railways in Prussia in or about 1878, the scheme as originally put forward, provided for a separate Railway Budget. The Swiss people voted in 1908 to nationalise their railways, only when it was specifically provided in the Act that 'the railway accounts shall be kept separate from the other federal accounts so that the financial position of the railways can at all times be clearly ascertained, and that railway earnings shall be devoted only to railway purposes.'

In Japan the Railway Budget was separated from the General Budget in 1919. In France the budget of the railways which were worked by the State was treated as an 'annexe' to the General Budget. In Italy the railways had always been a separate entity.

ECONOMY AND PLANNING

The broad principles embodied in the recommendations of the Acworth Committee were accepted by the Government and two further committees were appointed to suggest detailed measures for implementing these recommendations. These were the Railway Finance Committee, presided over by Sir Malcolm (later Lord) Hailey, and the Indian Retrenchment Committee of which Lord Inchcape was appointed Chairman. The Railway Finance Committee was appointed to consider the separation of the Railway Budget from general finance, and to plan the requirements of railways in regard to capital expenditure during the next ten years. The Inchcape Committee was appointed in 1922 to recommend economies in expenditure and ways and means for increasing revenue from railways.

The Railway Finance Committee recommended that provision should be made for larger capital funds for the immediate rehabilitation and betterment of existing lines and for the completion of works under construction. They further recommended that 'the programme should be prepared on a five-year basis, the provision for each quinquennial period being considered about two years before the termination of the existing period.' They also suggested that moneys voted for any one year but not spent within that year, should not lapse but should be carried forward to the credit of the railway administration. The Committee estimated that 'funds to the extent of Rs 150 crores should be devoted to railway capital purposes during the next five years to be spent exclusively on rehabilitation and the completion of lines already under construction.'

The Inchcape Committee opposed the recommendation of the Hailey Committee regarding Rs 150 crores to be spent in five years, on the basis of financial stringency, and laid down that further expenditure could only be justified 'if it can be satisfactorily demonstrated that this expenditure will increase the net earnings of the railways sufficiently to cover the additional interest involved.' 'The country,' they said, 'cannot afford to subsidise the railways, and steps should be taken to curtail working expenses as far as necessary in order to ensure that not only will the railways as a whole be on a self-supporting basis, but that adequate returns should be obtained for the large capital expenditure which has been incurred by the State.' They felt that a return of five and a half per cent on the capital expenditure cannot be 'regarded as excessive.' The Inchcape Committee further recommended the institution of a depreciation fund, greater decentralisation of control, a thorough investigation into the railway accounting

system, and supported some of the recommendations of the Acworth Committee regarding administrative reorganisation.

Although it took some time before the broad recommendations of these three committees could be implemented, these committees had not only made a very useful survey and analysis of the various facets and phases of railway administration, management and development, but had made recommendations which laid the foundations for the development of railways under state management, as a fairly autonomous wing of the administration, enjoying adequate financial autonomy.

IMPLEMENTATION

In 1922 the Railway Board was reconstituted and Sir Clement Hindley was appointed the first Chief Commissioner. A Financial Commissioner was next appointed to the Board, which had two more functional Members. The separation of railway finance from general finance could not be accomplished till September 1924, when Government accepted a resolution of the Legislative Assembly recommending to the Governor-General in Council that railway finances 'shall be separated from the general finance of the country and the general revenues shall receive a definite annual contribution from railways which shall be the first charge on the net receipts of the railways.' The resolution further recommended 'that any surplus remaining after this payment to general revenues, shall be transferred to a railway reserve up to an annual amount of Rupees three crores and in case of any excess over Rupees three crores, one-third of the excess shall accrue to general revenues.' The railway reserve apart from being utilised for securing payment of the annual contribution to general revenues was to be employed for arrears of depreciation, for writing down and writing off capital 'and to strengthen the financial position of railways in order that the service rendered to the public may be improved and rates charged may be reduced.'

The Assembly, in February 1923, recommended that the State should take over the management of the East Indian and the Great Indian Peninsula Railway Companies whose contracts were about to expire and thereby indicated its strong approval in favour of state management of railways as against company management. On 1st January 1925, the State took over the management of the East Indian Railway, and on 30th June 1925 the Great Indian Peninsula Railway was brought under state control. The separation of the railway budget from general finances in 1924, and the acceptance by the State in 1925, in principle at least, of the responsibility for the direct operation of its own railways, marked a revolutionary change in policy, and afforded railways considerable financial and administrative autonomy to conduct their own affairs and to initiate and carry out future policies on 'sound business principles.'

V. State Assumes Control

THE RAILWAYS entered a new phase of development in 1922. This was the final phase before India became free, and the entire railway system of the country, except a few light railways, was taken over for direct management by the State. During the intervening period, Government went on acquiring the control of company-managed railways as and when contracts with them expired. The companies, further, ceased to look up to the Secretary of State for help or interference and became more responsive to the Central Legislature and public opinion. The railway administration in general and railway policies in particular were more exposed to legislative scrutiny and public criticism. The powers of the legislature were no doubt limited, even illusory, but the intellectual calibre and popular influence of those who sat on non-official benches were so great that neither the Government nor the railway authorities could treat with impunity any criticism which had the support of a powerful section of non-official opinion in the new central legislature. During successive debates in the legislature on the Railway Budget, through a series of interpellations in the course of every session, and through several committees, almost every phase of railway activity and every aspect of railway policy came up for discussion. Added to this were the growing influence of organised labour, and a new-born consciousness of national self respect and dignity on the part of passengers and the general public.

THREE STAGES

Railway development during these years passed through three distinct stages: a period of exceptional prosperity up to 1930, followed by unparalleled depression, and then World War II. In 1924 the total route mileage of Indian Railways stood at 38,039. This was far short of the target of 100,000 miles laid down by the Mackay Committee in 1908. Sir Charles Innes, the then Member in charge of Railways in the Executive Council, announced a five-year programme in the Legislative Assembly, which besides a comprehensive rehabilitation and overhaul of existing equipment, included plans for constructing at least 1,000 miles of new track every year. The total mileage of projects which the Railway Board had

'either sanctioned or were having investigated by the end of March 1926 amounted to between 6,000 and 7,000 miles.' In 1928-29, the target of 1,000 miles a year was exceeded and 1,282 miles were opened to traffic. But on an average, during the eight years of abundance and prosperity (1924-32) only 5,360 miles could be added. In succeeding years, up to the war, additions were hardly worth the mention. During the war itself some of the existing lines were dismantled to help military operations abroad. The total amount of expenditure incurred on new railways from 1924-32 amounted to Rs 44·90 crores. During these eight years Rs 122·89 crores were spent on open line works, being 73 per cent of the total capital expenditure on railways, and Rs 75·29 crores on 'renewals and replacements.'

The capital expenditure on open lines fell into two classes: that incurred on stationary equipment, and that on mobile equipment. The stationary equipment consists of the road bed, stations, signals, projects, etc, and the mobile equipment represents locomotives, coaching vehicles, goods wagons, etc. Stationary and mobile equipment are however very closely interconnected. The introduction of heavier locomotives, larger capacity wagons, and higher speeds would necessitate corresponding improvements in the permanent way and station facilities, the use of heavier rails, strengthening of bridges, improvement of yards, enlargement of workshops, etc. The expenditure on stationary equipment during the period 1924-32 was Rs 85·67 crores or 70 per cent of the total capital expenditure. A sum of Rs 37·22 crores was spent on mobile equipment.

These figures are significant. They represent a colossal amount in terms of capital expenditure and show how many-sided was railway activity during these eight years, representing a peak period in national and railway prosperity.

ELECTRIC RAILWAYS

An outstanding development during this period was the introduction of electric traction on Indian Railways. Third of February 1925, represents a landmark in the history of railway development in India. It was on this day that the then Governor of Bombay, Sir Leslie Wilson, declared open the first electric railway, namely, the Harbour Branch section of the Great Indian Peninsula Railway from Victoria Terminus to Kurla. Soon afterwards the Great Indian Peninsula suburban line was electrified up to Kalyan and the main line up to Poona and Igatpuri over the Bhore and the Thal Ghats. The Bombay, Baroda and Central India suburban line was later extended up to Borivili and Virar. Work on the Madras suburban railway was started in 1928 and completed in 1931. All this involved enormous capital outlay and expenditure.

During this period large amounts of money were spent on doubling and quadrupling the track in many places, on strengthening and even rebuilding some of the bridges, on remodelling station yards, reorganising and improving

workshops, covering platforms or building new ones, building additional refreshment stalls, lower class waiting rooms, and on improving sanitary arrangements, etc. Large amounts were spent on constructing, renovating or making additions to several station buildings. Among the most outstanding of these new buildings were the suburban terminal station at Churchgate, and the Bombay Central, terminus of the Bombay, Baroda and Central India Railway in Bombay. The latter was constructed at an expense of Rs 1·5 crores. Victoria Terminus was remodelled and several expensive additions were made to the existing structure. Other notable stations reconstructed during this period were at Howrah, Kanpur, Lucknow, Trichinopoly and Erode.

BOOM PSYCHOLOGY

So great was the extent of railway prosperity during this period that Sir Charles Innes in his budget speech for 1926-27 complained that 'the principal difficulty with which we are now confronted is that of spending the money, that is, of executing rapidly, sanctioned projects.' In many cases it was found that the agents of railways had asked for much larger funds than they could hope to use. In order to encourage more rapid execution of plans and greater expenditure, the Railway Board hit upon the system of over-allotment. According to this system outlined by Mr Sim, Financial Commissioner of Railways, the estimates submitted by railway administrations were reduced by means of lump cuts, but they were told that they could spend up to the amounts they had asked for in the budget. The agents were given additional powers to start new schemes and in some cases the money for these schemes was sanctioned before the blue prints were ready or estimates could be prepared.

Several schemes were adopted on 'abstract estimates,' and the expenditure finally incurred on some of them was very much above that originally asked for. The Wedgwood Committee, for instance, gave the example of the Kangra Valley Railway which aroused a lot of criticism in the Legislative Assembly. The railway was originally estimated to cost Rs 113·80 lakhs. The final revised estimate stood at Rs 134 lakhs, but when the railway was opened to public traffic on 1st April 1929, it had actually cost Rs 296 lakhs. There was then the case of the Bally Bridge. At the time the scheme was put forward the Financial Commissioner remarked, 'It is somewhat difficult to justify the Bally Bridge scheme on strictly financial grounds.' Even then the Board accorded its approval to the scheme on 5th December 1925, and the estimate of cost was then placed at Rs 179·90 lakhs. In 1931 when the project was completed the actual cost came up to Rs 320 lakhs.

The Wedgwood Committee commenting in 1937 on the effect of this policy remarked:

> 'We cannot help feeling that in the past 15 years, stations, workshops and marshalling yards have often been built to be the last word in railway technique

rather than on a careful calculation of probable requirements, and that prestige has perhaps counted far more than prudence. It is the worst feature of such overgrown schemes that they continue to burden the railways with excessive interest charges involved.'

Whereas the capital at charge had only increased by 25 per cent by 1931-32, interest charges had gone up by 40 per cent. The operating ratio which till after the war (1919-20), despite abnormal conditions, higher cost of material, etc, had oscillated between 46 and 57 per cent, stood between 65·02 and 76·22.

During this period, however, substantial surpluses were made available to the State from its railway investments after meeting interest and other indirect charges from net earnings. Taking the figure of 1900, the surplus to the State in that year amounted to Rs 11 lakhs. During the five years ending in 1920, the actual average was Rs 11·48 crores. The contribution to general revenues during the first six years following the Separation Convention, *i.e.*, 1924-32, amounted to an average of Rs 5·90 crores, while a sum of Rs 2·79 crores was transferred additionally to the Reserve Fund. From 1932 onwards, expenditure remained almost steady, but there was a rapid fall in gross earnings.

In 1926-27, working expenses were Rs 69·37 crores and gross earnings Rs 114·75 crores. Between 1931 and 1934 the average working expenses continued to be in the neighbourhood of Rs 69 crores, while the average of gross earnings had dropped down to nearly Rs 97 crores. Thus the operating ratio had risen to 71 per cent. During the period of depression 1930-37 only one contribution of Rs 5·74 crores was paid by the railways to the general revenues during the first year 1930-31. If the contribution of 1930-31 were therefore to be spread over all the subsequent seven years, the average gain to Government would be little over four-fifths of a crore annually. It was at this juncture that Government began to think, in the words of the Member for Railways at the time, in terms of trying to 'stop up the hundreds of loopholes from which money is apt to leak away in times of prosperity.'

THE WEDGWOOD COMMITTEE

On 29th October 1936, the Indian Railway Enquiry Committee under the chairmanship of Sir Ralph E. Wedgwood, was appointed 'to examine the position of Indian State-owned railways,' and to suggest measures to 'secure an improvement in net earnings' and 'at a reasonable and early date place railway finances on a sound and remunerative basis.'

In the course of a comprehensive survey of financial and operational developments since the end of World War I, the Wedgwood Committee made several recommendations conducive to greater economy in expenditure and to increased efficiency in operation. It laid down among other things, a more rational

basis for the assessment of the Depreciation Fund. As a means for increasing revenue the Committee suggested the development of the commercial departments of the railways, and the appointment of a proper machinery for publicity and public relations. Under the Government of India Act 1935, a provision had been incorporated for the setting up, in the event of a federation being formed, of a Federal Railway Authority. While some recommendations of the Committee regarding the Federal Railway Authority are now only of academic interest, since the 1935 Act, so far as its federal section was concerned, was never put into operation, a few others became the basis of an Act of the Central Legislature whereby the powers of the Railway Board were enlarged and its autonomous character further defined and emphasised.

WORLD WAR II

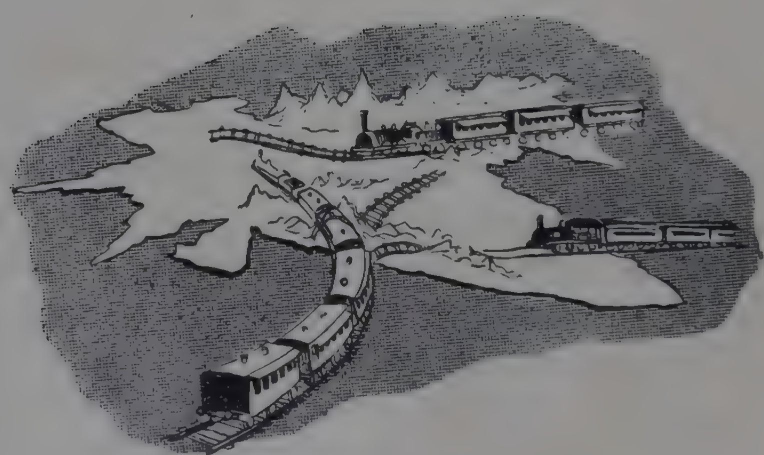
During the years of depression, the railway revenues had been insufficient even to meet the interest liability of the general revenues for the capital invested. Railways had drawn heavily on the Reserve Fund which had almost been completely dissipated, and, were making dangerous inroads on the amount at the credit of the Depreciation Fund. In 1935-36 a moratorium had to be declared and payments to general revenues completely suspended. In such financial difficulties, maintenance had to be slowed down or deferred from year to year, and renewals and replacements had to be limited to the minimum permitted by the requirements or the needs of safety in operation. In 1937 there was a distinct improvement, but in 1939 as the railways were endeavouring to turn the corner, and attempts were being made to catch up with the arrears of maintenance and replacement, World War II started. While paradoxically war brought prosperity to the Indian Railways and enabled them to replenish the Reserve Fund and to repay the arrears of contribution to general revenues, far from enabling them to rehabilitate their equipment, it placed a further strain on their resources, leaving the equipment in a state of battered disrepair.

During the war the Indian Railways were called upon to release locomotives, wagons and track material for the Middle East, necessitating the dismantling of as many as 26 branch lines. A large number of workshops were diverted to the manufacture of ammunition. At the end of the war there were abnormal arrears of renewals and replacements and the whole railway system had virtually broken down.

Soon after the war came Independence. With it came the partition of the country, and a division of railway mileage and railway assets between India and Pakistan. This created new problems and placed a fresh strain on the already battered and truncated railway system. After Independence, the entire railway system came under State control. In spite of the unhappy legacies of war and

partition and many unprecedented difficulties, the railways entered a new and the final phase in their development.

A hundred years ago the railways had started under company management. Later came the phase of company-managed and company-owned railways, existing side by side with state-owned and company-managed railways, and state-owned and state-managed railways. In the next phase the management and control of the major lines passed on to the State, but the control of the administration vested solely in the sovereign direction of the British Parliament. In the final stage the control of the railways passed into the hands of the State and the direction and sovereign control of the machinery of the State passed into the hands of the people of India.



VI. The Track

THE IDEA of a railway is to furnish two parallel lines of 'hard, smooth and unchanging surface for wheels to roll upon.' Simple as the idea must seem, its realisation in practice is attended sometimes with baffling difficulties and prodigious expense. Natural irregularities of the earth's surface must, in one manner or another, be reduced or removed. Low parts, and often deep valleys, must be filled up by embankments or viaducts. High parts have to be cut through by cuttings. If the height is too great and steep, it must be bored through by tunnelling. Rivers and water courses, large or small, need to be bridged. The carrying of a line of railway over deep gorges or valleys, over large rivers and patches of sea also requires the building of lofty viaducts approached by long gradually inclining embankments from both sides to enable the railways to pass over with safety. All this needs to be done with the ultimate object of reducing the whole route to one uniform and moderately level surface to be of easy negotiation by tractive power against the force of gravity.

Anyone looking at the map of India would see that among the countries in which railway enterprise commenced, India was not only one of the largest in area, but presented all the diverse physical difficulties encountered by railway engineers in any and every other country of the world. Climatically, India is a country with perennial snows, and extremes of tropical heat. Parts of the country are arid sandy desert, while others are full of lagoons and marshes. Weather conditions change from extreme dry heat in certain parts of the year to incessant continuous rainfall in others. Some parts of the country are so flat that for long stretches of endless miles the surface is even and smooth. In contrast there are regions with miles and miles of lofty peaks rising to thousands of feet in height, made up of rock in places, as hard as granite. Parts of the country are covered with thickly grown intractable jungles abounding in wild beasts. As against these, there are healthy, habitable fertile areas more thickly populated than any part of the world. The country abounds in rivers so dry in certain periods of the year that they would be indistinguishable from small fordable streams. During other seasons they reach enormous dimensions.

THE DECCAN

India has a coastline of 3,600 miles, extreme length of 1,800 miles and extreme width of 1,400 miles. Northwards, from the delta of the Ganga spreads a fertile alluvial plain of moderate elevation up to the feet of the Himalaya mountains. The Deccan is a characteristically elevated and more or less undulating plateau, occupying the greater part of the southern extension of the peninsula. Along the whole western seaboard, from the mouth of the river Tapti to Cape Comorin, the highland terminates abruptly in steep precipitous slopes and bald rocky bluffs, leaving a low maritime plain, seldom more than 30 miles in width, between them and the sea. The edge of the highlands from the Tapti to a gap which breaks through at Palghat in the neighbourhood of Coimbatore, is called the Western Ghats. The general elevation of its ridge line does not exceed 3,000 feet above sea-level, and it is at no place less than 2,200 feet. The maximum height reached, however, is 5,000 feet at Mahabaleswar and 6,000 feet in Coorg. To the south, the Nilgiri Hills run in the direction of Madras on to the eastern coast. The Ghats extend to the extreme southern point of the peninsula up to Cape Comorin. In width the Western Ghats range between ten to 49 miles. The Western Ghats consist of what is virtually an almost vertical steep, forming a kind of retaining wall to the Deccan highlands, so that a railway approaching them from the west, for example Bombay, has after 30 or more miles to climb the face of what is practically a line of sheer precipice from 2,000 to 3,000 feet in height, broken only along its front by deep rifts or ravines. From the edge of the Western Ghats the elevating plateau dips away to the east, terminating a short distance from the Bay of Bengal in a line of hills of more gentle contour than those on the west, called the Eastern Ghats.

The mountains forming the northern boundary of the Deccan tableland are composed of three distinct chains, *i.e.*, the most northern or Aravalli Range of hills, the central or the main Vindhya Range and the southern Satpura Range of lower hills. The Deccan comprises Madhya Pradesh, the greater part of Bombay State, Hyderabad, Mysore and the whole of Madras. In the north along the entire width of 1,400 miles lie the Himalayan Range of mountains at places more than 450 miles in depth with peaks rising to more than 29,000 feet in height.

INDIAN RIVERS

Indian rivers were another baffling difficulty requiring all the ingenuity, skill and resourcefulness of engineers in the building of serviceable bridges, viaducts and embankments. In the territory of undivided India as it then existed a hundred years ago, the principal rivers, the Indus and Ganga rising in the heart of the Himalayas, and fed by its eternal snows, flowed—the first, in a general direction, north to south, the second, west to east discharging themselves, into the Arabian

Sea and the Bay of Bengal respectively. The three principal tributaries of the Ganga are the Jamuna, the Gogra and the Sone. In the Deccan the upper tableland is traversed by a number of great rivers, which rising on the spur of the ghats on the western side of the peninsula flow across the whole extent of the plateau, break through the line of Eastern Ghats and descend to the Bay of Bengal. The chief of these are the Krishna, the Godavari and the Mahanadi between the Aravalli and Vindhya line of mountains. The river Chambal flows northwards to the Jamuna. Between the Vindhya and Satpura Ranges, the mighty Narbada flows in a westerly direction to the Gulf of Cambay and the Arabian Sea. Besides these major rivers, intersecting various parts of the country, run a large number of tributaries creating a network of waterways in the country.

From the point of view of the early railway engineers, the most important characteristics of the rivers were their great average size, the immense volumes of water periodically brought down by them during the flood season, the tremendous velocity of flow, the enormous extent of their inundations, and the erratic and unstable character of their channels. These rivers presented some of the most difficult problems in the technique of bridge building.

The Sind and Rajputana deserts presented different kinds of problems, namely, a sandy unstable soil, and absence of water for construction purposes over long stretches of territory.

CONSTRUCTIONAL PROBLEMS

It is in the background of these physical difficulties that the achievements of railway engineers in India have to be studied. It must also be borne in mind that a hundred years ago the equipment and appliances available for executing large constructional works were elementary as compared to those within the reach of engineers today. Staff had to be specially mobilised and trained. Equipment and material had to be transported on bullock carts and camel carts, and sometimes on mules and donkeys, and work had to be carried out in areas, in many cases, out of the reach of wheeled vehicles. Occasionally, engineers had to depend solely on the human agency. Some of the locations were in jungles and forests infested with wild beasts, where the danger of disease was ever present, or in arid deserts where water was not easily obtainable.

EARLY BUILDERS

Unlike some of the other countries, though the art of building was not new to the people, the technique of railway construction was new to India, and had its own peculiar difficulties. At a time when some of the people of Europe and of the other continents were living in structures of primitive and elementary construction, Indian engineers and craftsmen had shown remarkable ingenuity and skill, in

constructing some of the most spectacular buildings of the world. These even today evoke the admiration of modern engineers. Cities like Harappa and Mohenjodaro (3000 B.C.) reveal a very advanced state of culture, and a fairly highly developed knowledge of the art of construction. Wide roads, roomy and well-built houses, the existence in them of well constructed wells and bathrooms, and an elaborate drainage system, all betoken a state of advance far ahead of other countries of the world.

Anyone travelling through India can even now witness some of the ancient temples, palaces, fortresses and stupas, and remains of what in their own time must have been rich, prosperous and magnificent cities, which bear testimony to the highly developed knowledge, remarkable skill and extraordinary resourcefulness of the constructional engineers of early times. Quite a number of these buildings can be traced back to three thousand years. Some of them reveal technical features which were new to the engineers of Europe even up to five hundred years ago.

Tunnelling, again, was not new to India. It is true that some of the bigger and longer tunnels like the one from Delhi to Agra were constructed in the days of the Moghuls, but the remains still exist of smaller tunnels connecting forts and palaces through which elephants could easily pass, which were built as early as 400-300 B.C. Anyone visiting the magnificent caves at Ellora, Ajanta, Elephanta, Khandagiri and Udaigiri, can testify to the fact that Indian engineers even 2,000 to 2,500 years ago were experts in the art of tunnelling and rock boring, possessed a very advanced knowledge of geological strata, and were capable of carving out of rock structures which are even today the wonder of mankind.

EARLY HIGHWAYS

The Rig Veda, compiled several thousand years ago mentions the existence of highways—Mahapatha—in various parts of India. In the excavated remains of the ancient city of Harappa (3500 B.C.) has been discovered the copper miniature of a two-wheeled cart with gabled roofs with a driver's seat in front. This is probably one of the oldest representations of a wheeled vehicle in the world. Kautilya, the Prime Minister of Chandragupta, the first Mauryan Emperor, 322 to 298 B.C., gives detailed rules regulating the width of roads for various purposes and various kinds of traffic, for example, chariot roads, royal roads, roads leading to military stations and to villages. According to V. A. Smith, a British historian, King Chandragupta Maurya, constructed the first 'Grand Trunk Road, 10,000 stadia (700 miles) in length connecting the north-western frontier with the Capital (modern Patna).' Roads in ancient India are also described in one of the rock edicts of Emperor Asoka (273 to 237 B.C.) which says: 'On the roads also banyans were planted and at each half Kos (five furlongs) wells were dug; also rest houses made; many watering stations also were made in this and that place for the comfort of

cattle and men.' Fa-Hien, the first Chinese traveller who visited India in the fifth century A.D., travelled by road and river, and mentioned in his memoirs the existence of rest houses for travellers all along the highways, 'where many amenities were provided.'

Emperor Sher Shah (1530-45) did a great deal to further improve and develop the roads in various parts of the country. Mention is made in the Tarikh-i-Shershahi of his having built a continuous road from the Punjab to the city of Sonargaon, in Bengal 'on the shores of the ocean.' He built 'a road from Agra to Burhanpur in the kingdom of Deccan, a road from Agra to Jodhpur and Chittore and another from the city of Lahore to Multan in Northern India.' Mention is made in 'Chahar Gulshan' of as many as 24 main highways connecting Delhi in the north with Kabul and Kandahar, in the east with Bengal, south-west with Aurangabad and Golconda, and west with Ajmer, Bijapur and Ahmedabad.

Constructional engineering, as applied to railways, however, required skill and resourcefulness of a different character, and presented problems which had not hitherto been encountered in road building. In the laying of railway lines, the physical features of the country left very little choice as to the alignment of the track or the particular routes the line should follow. If Bombay had to be connected with Madras and with other stations in eastern and northern India, methods had to be found to attack the Western Ghats, and to force an easy alignment for the railway track, not only through and over the Ghats, but also through and over the undulating jungle country of Khandesh and the Deccan. Similarly, it was not possible for any line to connect Calcutta with Delhi or Central India to the east, unless ways and means could be found to bridge the Ganga, the Jamuna, the Mahanadi, the Sone, the Narbada, the Godavari and a large number of their flood bursting tributaries, some of which had hitherto never been tamed or circumscribed by man-made structures.

VII. Battle of the Ghats

CONSTRUCTION of a railway line from Bombay to Kalyan, involving one tunnel, a long viaduct and several embankments and cuttings, was a difficult constructional feat by itself. It took nearly four years to accomplish. But it was child's play as compared to laying a track over the ghats. This involved problems and difficulties, greater and more complicated than had hitherto confronted railway engineers anywhere in the world.

The story of the Western Ghats is in many respects the story of the Indian Railways. These ghats represented the big obstacle confronting railway engineers at that time. Even after a hundred years, they continue to be a problem requiring all the skill and ingenuity of railway engineers, working under modern conditions. The constructional achievements of the engineers in the region of the Western Ghats, during the eighteen fifties were as outstanding for that period, as have been their more recent achievements in the nineteen fifties.

THE PROBLEM OF THE GHATS

In the eighteen fifties, the problem obviously was to lay a railway line across the Bhore and Thal Ghats to connect Bombay with Madras on the one hand, and with eastern and northern India on the other. During the last few years the problem has been to widen the tunnels, to open up new cuttings, and to build fresh viaducts for new alignments for the purpose of widening track centres. This had to be accomplished without interfering in any way with the heavy normal flow of daily traffic.

The first section of the railway line from Kalyan to the northeast and in the direction of the Thal Ghats is nearly 42 miles in length, extending from Kalyan to Kasara. On this length the line gradually climbs by steep gradients of 1 in 100 and by sharp curves down to a radius of 30 chains to an elevation of 948 feet above sea level at Kasara. The works on the section are of a heavy character. The earthwork formation consisted of over half a million cubic yards of cutting through hard trap and basaltic rocks and over one and one-third million cubic yards of embankment.

The second section about nine and a half miles, was later opened from Kasara to Igatpuri. The line from Kasara to Igatpuri is a difficult ghat section abounding in sharp curves and steep gradients. About three-fourths of its length is laid over curves, the sharpest curve being 17 chains in radius in a length of 2,170 feet. Another curve of 20 chains has a length of 3,000 feet. The line has to cross over several nullahs, ravines and reefs, and passes through numerous tunnels, keeping virtually to a constant gradient of 1 in 37, to rise from a level of 948 feet to 1,918 feet above sea level, in a distance of nine and a half miles.

The quantity of earthwork, consisting for the most part of hard rock material, was no less than two and a half million cubic yards, the quantity in cuttings and embankment respectively being about equal. The greatest depth of cutting is 60 feet and the maximum height of the embankment above the level is 90 feet.

OUTSTANDING ACHIEVEMENTS

Some of the viaducts and tunnels on this line are considered outstanding achievements in civil engineering and are among the finest works in the world.

The Ehegaon viaduct is a magnificent structure, 750 feet long and 182 feet high. The viaduct is situated in a steep valley nestling in the midst of hills that skirt around it in the form of a horse-shoe. The line approaches the valley by two tunnels and then is carried across the yawning chasm on a tall imposing structure known as the 'Ehegaon Viaduct.'

The viaduct originally consisted of three pin-truss deck spans with two girders under each track, and three 40 feet masonry arches at each end. The girders were fabricated on the ground, and jacked up through the whole 182 feet height, their ends and the jacks being in vertical grooves or recesses in the pier masonry, which was built up to fill the grooves as the jacking progressed. In 1899, these girders were replaced by single girders placed between each pair of the old girders under traffic. After the decking had been erected, the old girders were removed.

These girders, however, were found to be weak for modern requirements of traffic, and a speed restriction of ten miles per hour was in force over the girders for many years. In 1949, the viaduct was converted from a double line into a single line bridge, the cross girders were strengthened and the speed restriction was removed. The traffic in the other direction towards Bombay was passed by a separate diversion when the work in connection with the ' widening of track centres ' was undertaken and completed in 1951.

Among the other large viaducts are two with lengths of 450 feet and 429 feet and heights of 60 feet and 84 feet respectively. The total length of six lofty viaducts on this line is 2,230 feet.

The line has to pass through several tunnels bored through geological strata of varying character. The two longest tunnels are 1,461 feet and 1,271 feet in length respectively. The total length of all the tunnels on this line is 7,966 feet.

THE BHORE GHATS

The works necessary for laying of the line up to the Bhore Ghats have also been of extraordinary magnitude and difficulty. The line on the Bhore Ghats ascends similarly over mountains in which the geological formation is the same and physical difficulties almost identical. The altitudes of the two ghats closely correspond: the summit of the Bhore Ghats incline being 2,027 feet and that of the Thal Ghats 1,912 feet. The maximum gradient of both inclines is the same: 1 in 37. The extreme curvature is almost identical, that of the Bhore Ghats being 15 chains as against the 17 chains radius on the Thal Ghats. In the case of the Bhore Ghats, however, engineers found the mountains frequently scraped and had to deal with deep faces of bare rock. The works on the Bhore Ghats comprised 25 tunnels of a total length of nearly 4,000 yards, two of the longest being 435 yards and 341 yards respectively. The Bhore Ghats have eight lofty viaducts having a total length of 2,961 feet. Two of the largest are more than 500 feet long with a maximum height of 160 and 163 feet. There are 22 bridges of spans from 7 to 30 feet and 81 culverts of various sizes.

Illustrative of the problems and perplexities encountered by the engineers of the time is the story of the viaduct known as Mhowke Mullee. This viaduct on the Bhore Ghats had been completed in 1856. It consisted of eight 50 feet arches, the greatest height from the surface of the ground to the rail level being 135 feet. Soon after the completion of the viaduct, various stories spread of rumbling noises arising from the ravine from the base of the viaduct, creating a scare among the villagers. Numerous petitions were received from the villagers invoking superstitious beliefs to impress the authorities that there was something seriously wrong with the viaduct. Slight cracks were known to exist, but a careful watch had shown that they were not extending. No heed was paid to the warnings of the villagers. A few days previous to the fateful 19th July 1867, the Chief Engineer and the Deputy Consulting Engineer had fully inspected the viaduct and had failed to find any cause for anxiety. At 6-30 am, on Friday, 19th July 1867, the last train passed over the viaduct. A plate layer who was in the act of tightening the keys in the track suddenly felt the ground giving way under him and 'ran as fast as he could, with his eyes closed, to the end of the bridge.' Turning round he discovered that the viaduct had collapsed. Mhowke Mullee has no longer a viaduct. The whole place has been filled in and is now indicated by a continuous embanksent.

Above left : Bhore Ghat, Deversion No. 3, Jewel-studded Tunnel No. 7-A. While the works were in progress even a hundred years ago various types of zeolite crystals were found during the borings. In 1950, when widening of the tunnel was in progress, news of the crystals gave rise to a lot of excitement as some people thought that 'jewels' had been discovered in the tunnels.

Above right : Bhore Ghat, Diversion No. 7, Original tunnel on the left showed signs of falling boulders and had to be supported by steel centering and a second tunnel had to be built o accommodate the double line.

Right : Another view of the old and new tunnels.

Below The same tunnel showing the engine of a construction train steaming out of the new tunnel.

Above : Thal Ghat, Igatpuri—Diversion of one line necessitated by infringements for double line in the old tunnel.

Right : Budni-Barkhera doubling. Construction of new Down Main Line showing the Bombay end view of Chowka Tunnel.

Below : Thal Ghat, Igatpuri.—A view of Ehegaon viaduct, showing three spans of 140-feet girders, deck type.

Above : The old Bhore Ghats Reversing Station which was eliminated in 1928 by re-alignment involving the construction of three tunnels.

Left : Budni-Barkhera—Crane hauling steel centering for construction of arch-lining in tunnels.

Below : A view of the completed Saranda Tunnel, Budni-Barkhera.

Above : Parsik Tunnel—Between Bombay and Kalyan, Central Railway, the longest in India, 4,322 feet long, constructed during 1913-16.

Right : Day-lighting' of Tunnel No. 8, Thal Ghat. The lining of the tunnel is being dismantled and the photograph shows the crane and the cradle lifting the crown stones off.

Below : Photograph showing work in a block during which the travelling staging has been moved forward and the roof has been blasted. Note the temporary ties holding the two footings of the travelling staging together while it is being moved.

PECULIAR DIFFICULTIES

Among the many peculiar difficulties encountered both on the Bhore and the Thal Ghats inclines, were the unhealthy nature of the hot and rainy season—the maximum rainfall being 200 inches in certain parts—fatal epidemics which often scared and dispersed the armies of men engaged on the works; the rugged and precipitous character of the ground impeding the haulage and transport of material; the sudden and dangerous landslips from the hillside, the extreme hardness and solidity of the trap rocks, the large number of deep ravines and canyons; the general scarcity of water during certain periods of the year and excess in others; and the presence of wild beasts and dangerous reptiles. Lord Elphinstone referring to the difficulties encountered in the ghats observed, 'I fear that whichever way the rail road is made we must be prepared for very numerous casualties. Every possible means must be taken to lessening the risk —but it would be idle to expect that we shall carry on a victorious campaign on the Danube without loss, or we should successfully overcome the physical difficulties which we have to confront in making railroads in such a country as India without heavy sacrifice of human life.'

In the rainy season of 1859-60, work was brought to a standstill by the visitation of cholera which caused a large number of deaths among labourers. The number of those engaged in these works normally averaged from 30,000 to 40,000. The casualties were thirty per cent.

There are probably but few travellers daily passing up and down the precipitous Thal and Bhore Ghats, completing their journey in a few hours, which earlier used to require several days by horse carriage or bullock cart, who can adequately realise the stupendous nature of the obstacles which had to be overcome, and the great skill and daring of those who in the early years of railway construction, shaped and carved out of the rocky mountain side, the railway lines which now connect Bombay with other parts of India. To get some conception of their magnitude and the unique character of the skill represented by them, it is necessary to pass along, either on foot or in open trolley, and to closely observe all the numberless ingenious expedients resorted to, to make the rough ways smooth, for converting the natural inequalities of the precipitous hills into a series of uniform incline surfaces, as well as closely regarding from below and above the details of the towering embankments and masonry viaducts by which the low parts have been filled, and the constantly recurring wide and extensive tunnels or deep rocky cuttings, by which the projecting mountain regions and bluffs have been pierced, until the whole uneven, rocky and inhospitable region has been smoothed and rendered easy and secure for daily transit, at all seasons, of railway traffic, of goods and passengers, which during the last 100 years has been heavier than in other parts of India.

A BOTTLE-NECK

A line of railway, with its tunnels, bridges, and viaducts which was considered a hundred years ago as one of the world's greatest engineering achievements, and serviceable enough for the then transport requirements of the country, presented new problems in a more perplexing and a more complicated form to Indian engineers in recent years. It required as great courage and even much greater technical skill and resourcefulness as was needed by early engineers to carry out some of the urgent improvements necessitated by the increase of traffic. It was felt even more than 30 years ago that the existing double track lines had been laid very near each other and were not only likely to cause accidents but were unsuitable for rapid flow of traffic.

The tracks on the Bhore and Thal Ghats sections were originally laid at twelve feet centres, providing a clear space of six feet between the two lines (no doubt a copy of the British six feet). This track spacing proved to be insufficient for passing modern wider rolling stock, which is now being adopted on the Indian Railways, and the necessity for widening track standards to the current standard of 15 feet 6 inches, centre to centre, was felt.

The close spacing of track centres constituted a serious bottle-neck in rapid movement of heavy traffic and prevented movement of 'out-of-gauge' loads that have frequently to be passed through these ghats. The widening of track centres on the Western Ghats, therefore, became a matter of very urgent importance, and work on this project was taken in hand in 1945, eighty years after the original tracks had been laid on these steep ghats inclines. The work was completed in 1951 at a cost of two crores of rupees.

The problems involved in widening the track centres from twelve feet to 15 feet 6 inches centres, in the open as well as in the tunnels, fell mainly under the following categories:

(a) widening of existing banks and cuttings on the existing alignment, in the open, where the nature of the ground permitted;

(b) widening of tunnels, under traffic, on the existing alignment where geological and physical conditions made this possible;

(c) where methods (a) and (b) could not be employed, provision of new deviations or diversions around tunnels for single line track only. The other track was allowed to remain on the old alignment and shifted to the central portion inside the existing tunnels to allow plenty of side room.

(d) In the case of certain tunnels, where the top overburden was small, it was found more economical to convert such tunnels into open cuts, the operation being known as 'day-lighting of tunnels.'

In carrying out these works, modern methods of construction and equipment were employed, and in some cases novel means were devised to carry out the work without any interruption to traffic. The most interesting of these were the 'widening of tunnels' and 'day-lighting of tunnels.'

NOVEL DEVICES

For widening tunnels under traffic, a special steel staging was erected inside the tunnel, the minimum clearance of which permitted traffic being passed through the tunnel under the steel staging with a speed restriction. The steel staging in this position allowed the drilling staff to drill holes in rock without interfering with traffic. For actual blasting of rock for widening of tunnels, the work was carried under 'occupation blocks' during which time no traffic was permitted and all the electric overhead wires were made dead.

Day-lighting of tunnels involved opening out of the cover of the tunnel and converting it into an open cut. The rock overburden over the tunnel lining was first removed by means of carefully controlled blasting until the top of the tunnel lining was laid completely bare. The next step was the dismantling of the arch in the roof lining. The operation was carried out very carefully by means of a special cradle which engaged the central portion of the lining arch like a jaw. The cradle was operated by means of a crane and after engaging the central portion about five feet wide, the cradle was lifted bodily by the crane, and the central masonry in the arch removed completely. The masonry in the haunches of the arch was also removed, bit by bit, by means of the cradle. The side walls were then dismantled by controlled blasting and the cutting widened to the required dimensions for accommodating the tracks at the standard spacing of 15 feet 6 inches.

ANOTHER BOTTLE-NECK

Another ghats section deserving special mention is the line between Budni and Barkhera which has an unbroken ascent of twelve miles over the Vindhya Ranges with a gradient of 1 in 80. This line was opened to traffic in 1884.

Barkhera at the top of the incline is at an elevation of 1,540 feet above sea level while Budni at the foot of the hills on the north bank of the Narbada river is 530 feet lower. The line as originally built was meant to operate on a pusher gradient—all ascending trains taking the assistance of a banking engine. This arrangement, however, has been very unsatisfactory, leading to serious 'bottle-necks' and congestion of traffic.

The work was therefore taken in hand in 1948, for doubling the line from Budni to Barkhera, but in order to enable an even and unrestricted flow of traffic to be handled on the ghats in the ascending direction, it was decided to locate the new line on a different alignment with a relatively flat gradient of 1 in 125.

Special equipment has been employed in most of the constructional works and some ingenious methods have been adopted to overcome the extraordinary difficulties arising out of local conditions. A fleet of modern earth movers such as crawlers, motorised scrapers, excavators, dumpers and sheep foot rollers has been employed for carrying out earth work. A total of 21 machines have been employed to complete over 180 lakhs cubic feet of earthwork in 200 days.

In the designing and construction of bridges, modern techniques have been adopted. Concrete—both plain and reinforced—has been employed on a large scale in building durable and economic structures. The major bridge across the Gadaria may be taken as a typical example of construction methods and devices employed on the project. The river at the crossing runs into a gorge and hence a 'buried' abutment has been provided on the north bank. The piers and abutments rise 65 feet above their foundations to carry the bed blocks.

For the purpose of tunnelling, a multi-purpose travelling protective shield fabricated of plates and mild steel sections has been locally designed and used. This shield acted not only as a canopy for the protection of the labour working at the locations, but also as a 'jumbo' or 'staging' for drilling holes in rock and for erecting the tunnel steel supports.

It will be seen, therefore, that the ghats started as the original big problem in the way of building railway lines. After hundred years of development they still continue to be a baffling problem for railway engineers. The building of the original track on the ghats inclines, or even the Vindhyachal tableland, may seem to the thousands who take a train journey over these areas as something quite ordinary, but the achievement of those who carried out the projects during the past hundred years must strike the technical man who has had something to do with constructional engineering, as a series of signal landmarks in constructional engineering.

VIII. Bridges

BRIDGE building in India, like tunnelling, or even like laying the track over the ghat inclines, and through the marshy jungles of Khandesh and Central India, was no easy job. Climatic conditions during certain periods of the year in most places are far from favourable and can at times be very trying. To these was added the most vital and challenging difficulty, the indeterminate character of the subsoil under river-beds, and the volume of water registering seasonal variations of a magnitude unknown in any other part of the world.

Some idea of the peculiar characteristics of Indian rivers may be obtained from a description of the territory between Howrah and Rajmehal, which was the earliest to be explored for the construction of a railway between Calcutta and Delhi.

> 'The first division of the railway from Howrah to Burdwan, and northward to Rajmehal and the Ganga Valley,' writes G. W. MacGeorge in his book, 'Ways and Works in India,' 'traverses a low portion of deltaic land, subject to extreme inundation for the water system of the country, where the drainage problems to be encountered and solved by the engineers of the railway were of exceptional and extraordinary magnitude. Over this wide expanse of level country, subject to an excessive tropical rainfall, inundations from the flood spill of the enormous channel of the Ganga and other great rivers are often spread as a vast sheet over miles of country, converting the whole district into the semblance of an inland sea from which only the inhabited villages along the higher marginal levels emerge.'

METHODS AND MATERIALS

Before describing some of the outstanding achievements in bridge building in India, it is interesting to study very briefly some of the methods employed by the bridge builders, and some of the materials principally used in constructional work, keeping in view local conditions. In the construction of bridges iron has been employed probably more in India, than in many other countries. Although the advantages and economy of masonry structures were fully recognised by early builders, and even in recent years, Indian engineers have kept themselves abreast of engineers in other countries in the field of pre-stressed concrete, iron and steel were used to a very large extent for the superstructure of railway bridges. This

was done not only in cases where the unavoidable size of opening rendered its use imperative, but to a considerable degree in cases where in other countries stone or brick arch work would have been preferred. In many parts of India either stone could not be economically procured or good brick-earth was difficult to obtain. In some cases the conditions of subsoil for foundation purposes were considerably unsuitable for arch works. 'Iron or steel bridges of large average size,' observes MacGeorge, 'are imposed by the magnitude and conditions of the numerous great rivers of the country, and India is consequently, in a pre-eminent degree, the land of heavy bridge work for railway purposes.'

The foundations of many of these large structures presented difficulties and problems peculiar to India. The usual method of founding the abutment and piers of large bridges in the sandy beds—extending often to unknown depths of the great rivers—in most of the early constructions, has been by sinking cylinders, or wells of brickwork, either singly or in groups, on which the pier superstructures were built; or by sinking the whole pier in an elliptical or other form by means of well-openings or chambers provided in the mass of masonry. This system though novel to civil engineering in other parts of the world, is one which is an improved and highly-developed adaptation of old methods practised in India for centuries. Nearly all the ancient bridges of upper India were formed of brick cylinders sunk into the sandy beds of the rivers. Railway engineers recognising the suitability of this method, reduced the practice of foundation well-sinking to a highly developed art. In the course of years numerous mechanical contrivances and expedients have been devised for rapidly sinking the cylinders to great depths. The principle on which these devices have been developed, however, remains the same. In these wells, the brickwork is commenced on timber, or more usually on wrought-iron, or steel curbs of great strength, suspended by vertical tie-rods passing through iron rings which are inserted at intervals in the masonry. In the case of circular wells, the internal diameter is generally about half the external diameter so that the thickness of the brickwork is a quarter of the whole width. The sand or other material encountered in sinking is gradually withdrawn through the central hollow of the well by means of suitable devices. These foundation wells are frequently forced down to great depths such as 80 to 100 feet, reaching even 140 feet. As the rivers, especially in upper India, contain little water in the dry season, it is during this period that most of the well-sinking is done and the protective stone is deposited, the latter work being often continued for several seasons.

THE SONE

Among the most notable and outstanding railway bridges constructed in earlier years is the one built on the Sone near Arrah. Work on the bridge was originally started in 1856. Lord Elgin, the then Governor-General of India, while

performing the opening ceremony in February 1863, declared that 'this magnificent bridge was exceeded in magnitude by only one bridge in the world.' The bridge might have been completed earlier but for the political upheaval of 1857.

The Sone River, rising in the elevated districts of central India discharges itself into the Ganga near Patna after draining an area of 23,000 square miles. Its extreme discharge in floods is said to be one and three-quarter million of cubic feet per second. The chief peculiarity of the river is the great width of its channel in the lower reaches. For the greater part of 100 miles it is over two miles wide, spreading occasionally to even three miles. The wide expanse of the bed, through which during eight or nine months of the year only a narrow stream meanders, consists entirely of fine sand, appearing to the traveller like the surface of a great sandy desert. It is only when these peculiarities of the river-bed are borne in mind that the signal achievement of those who finally constructed the bridge can be fully appreciated. Four thousand seven hundred and twenty six feet in length, the bridge consisted of 28 decked spans of 157 feet each being 14 feet 6½ inches deep and carried on three brick wells of 18 feet diameter sunk to a depth of 32 feet below low water into a stiff bed of yellow clay. The initial cost of constructing the bridge, which was completed for a double track was Rs 43 lakhs.

Another bridge on the same river was constructed in 1900 at a cost of Rs 32,32,000 called the Upper Sone Bridge. This bridge has 93 spans of 105 feet and has a total length of 10,052 feet. It ranks perhaps even today as second or third in length among railway bridges of the world.

THE TONSE

The bridge over the Tonse River on the Allahabad-Jubbulpore section about 20 miles south of Allahabad, was opened in 1864. In 1870 the Duke of Edinburgh while proceeding to Jubbulpore commemorated the crossing of the bridge by affixing a silver rivet into the iron superstructure of the bridge. The bridge has seven spans of latticed iron girders of 150 feet clear opening, and the piers and abutments are constructed of brickwork. The cut waters, being faced with dressed stone, are carried on groups of brick wells each twelve feet in diameter sunk into clay at about fifteen feet below the river bed. The girders have deck spans carrying an ordinary roadway below.

THE JUMNA

Further north, two large bridges had to be built on the Jumna River, to link the railway line with Allahabad and Delhi. The famous Naini Bridge near Allahabad was opened to traffic on 15th August 1865, and the bridge at Delhi was completed in 1866. The Naini Bridge is an impressive structure of large openings and of much greater height than the bridge over the Sone, although somewhat shorter

in length. The bridge consists of 14 spans—carrying a cart road below—of 200 feet each, and three small openings of 30 feet. The piers, which are 60 feet high above low water are founded on groups of twelve brick wells, each 13 feet 6 inches in diameter, sunk to an average depth of 42 feet below low water. The average height, therefore, of the pier masonry from the well curbs to the underside of the girders, is 102 feet. The total length of the bridge from end to end is 3,235 feet.

The famous Jumna Bridge at Delhi has a total length of 2,640 feet and is almost similar in construction to the Naini Bridge.

THE GANGA

The largest and most important of the bridges over the sacred Ganga is the one situated at Banaras (Kashi) called the Dufferin Bridge, now renamed Malviya Bridge. It was officially opened in 1887 by Lord Dufferin during whose Viceroyalty it was constructed. 'This splendid work' observes MacGeorge, 'is undoubtedly in some respects the most perfect specimen of railway bridge engineering in India.' A great deal of research and study were required before the engineers could determine the total length of bridge water way, the size of individual spans, the type and size of piers and the necessary depth of foundations, the design and the character of the superstructure, whether the bridge could be used both for railway and vehicular traffic, and the most economic and expeditious methods for its construction. In consideration of the limits of scour and high floods it was deemed necessary that the foundation caissons should be sunk in pure sand to a minimum depth of 120 feet below low-water level—that is to 83 feet below the ordinary dry season bed in its deepest part. The larger girders were of the compound triangular type, 355 feet 6 inches in length and 35 feet 4½ inches in depth. The smaller girders 113 feet 8 inches in length by 11 feet 5¼ inches in depth were used, so that both rail and cart traffic could be carried on the same level between the large girders, and over the top of the smaller extension spans. After several alterations had been considered for getting the huge main span of girders worked into position, such as floating them into place by the aid of pontoons, or raising them very near the water-level by hydraulic lifts, the girders were finally placed by very cleverly arranged stagings of full height, erected on the river-bed between the piers.

Between the period 1887 and early 20th century, several other notable bridges were constructed in the north: the Sutlej Bridge, 4,210 feet; the Alexandra Bridge over the Chenab, 9,088 feet; and the Kaiser-e-Hind Bridge over the Sutlej, nearly 4,293 feet in length. The most spectacular of the early bridges in the north, and ones which could compare 'favourably with similar structures in any part of the world' were the two bridges over the Indus River, one at Attock and the other near Sukkur, both of which are now located in the territory of West Pakistan.

Above : Bridge over the Rayaghada Gorge on the Raipur-Vizianagaram Section, Eastern Railway. Note the unusual features of the construction of the bridge.

Below : Trestle Bridge near Katni on Central Railway.

Below : Upper Sone Bridge, opened on 22nd February 1900, 10,052 feet long, Eastern Railway.

Below : Evelyn Bridge on Khargpur-Gomoh Section, opened on 1st January 1907, Eastern Railway.

Above: A panoramic view of the Dufferin Bridge over the Ganga, as originally constructed looking at the girder from the right bank up-steam side.

Left: A view of the blockhouses at the Kashi (Banaras) end of the Dufferin Bridge. Observe the platform of Kashi station in the foreground.

Below: The same bridge as regirdered in 1947 and renamed Malaviya Bridge.

Above : The Jubilee Bridge near Bandel, opened on 15th March 1887, Eastern Railway

Willingdon Bridge near Bally, Eastern Railway.
ove Left : The girder span moved into position. *Above right :* A view of the roadway. *Below :* View of the completed Bridge.

Above : Tapti Bridge, erected in 1871, Western Railway.

Below : Tapti Bridge being regirdered.

Rupnarain Bridge, Eastern Railway.

Above : Two views of regirdering.

Below : Two close-ups of the Bridge regirdering.

The Attock Bridge 1,655 feet in length has five openings having first three spans of 257 feet and two spans of 308 feet. The Sukkur Bridge is a cantilever bridge consisting of a single cantilever, one on each side of the water channel each having a projection or overhanging of 310 feet. The central gap, 200 feet long, between the projecting ends of these cantilevers is spanned by independent girders, each cantilever consisting of gigantic shear legs, or guyed crane, used to support the bridge platform at a height of 52 feet above low water, or 35 feet above maximum floods.

THE NARBADA

Rivers in the west, the Narbada, the Tapti and the Chambal are erratic and treacherous both in respect of their course as well as the subsoil under their bed. It took a lot of survey and skill, and a great deal of ingenuity and labour, before these rivers could be spanned at various places. The fact that one of the bridges over the Narbada was washed away after being built and another was seriously damaged, is fairly illustrative of these difficulties. One of the bridges built over the Narbada in the early eighteen seventies was seriously endangered by a flood in 1876. It was repaired and was kept constantly under observation. Eventually it broke down as a result of flood three years later. The bridge was finally replaced by an entirely new viaduct in 1881, the total length of the new structure was 4,687 feet 6 inches. Another bridge over the same river built some years later and having a length of 1,228 feet met with tragedy during the high floods of 1926. One of the 206 feet spans was carried away by the water nearly half a mile downstream, and a lot of ingenuity was required to recover the girders from the river bed, and to re-place them on the piers.

THE MAHANADI

The line from Calcutta to Orissa and further down to Madras presented problems of a different kind. The number of major rivers and their tributaries which required to be crossed was very large. The Mahanadi and its several tributaries: the Brahmani, the Hesth, the Kuakhi, the Birupa, the Baitarni and the Bonan; the Wain Ganga and its tributaries; the Godavari, the Rupnarain and its tributaries, the Cossye and the Damodar; and further east the Subarnarakha and the Langulya, constituted a vast continuous network of zig-zagging waterways. with a soil bed posing a variety of problems, over which a system of bridges had to be built. In total bridge and embankment length, and variety of construction technique required, these works have no parallel in the world.

The Mahanadi throughout its course of about 500 miles flows through very hilly country and is subject to very heavy floods. Its discharge is out of all proportion to its drainage area, that is 52,000 square miles. At the town of Sambalpur its direction is changed to south-east, and in the next 20 miles it receives

only three feeders of any considerable magnitude, all on its right bank. At Naraj Gorge, after passing through the narrow defile of only 2,800 feet in width, it debouches on to the plains, dividing at once into two main branches, the Mah proper on the left, and the Katjuri on the right.

In early years several proposals with comparative estimates for different alignment were put forward. It was in November 1896, however, that it was finally decided to cross the river below Cuttack, by means of five separate bridges, spanning the Barang, the Kuakhi, the Katjuri, the Mahanadi and the Birupa.

The Kuakhi Bridge has 20 spans of 150 feet each. The Katjuri Bridge consists of 18 spans of 150 feet girders, carried on wells 26 feet 6 inches in diameter sunk to an average depth of 73 feet below low-water level. The Mahanadi Bridge is situated half a mile below the anicut at Jobra, which is part of the headworks of the system of canals which connect with the Mahanadi at Cuttack and irrigate the whole delta. The total length of the crest of the anicut is 6,349 feet. It was therefore decided, to construct 64 spans of 100 feet each carried on wells 19 feet 6 inches in diameter, sunk to an average depth of between 50 and 70 feet below low-water level.

The Birupa Bridge which is the last of the Mahanadi series, consists of 16 spans of 100 feet girders carried on wheels of a type similar to those used on the Mahanadi Bridge.

In the black silt on which the Mahanadi series of rivers flow, the wells had a tendency to hang. In one case the dredging had proceeded to a depth of 30 feet below the level of the curb before the well began to move. It then dropped 26 feet without receiving the slightest damage. In another instance, a load of 1,200 tons was necessary to produce movement. The well then dropped 17 feet 6 inches leaving the load of rails behind it on the sand. On the Brahmani Bridge works, a hollow exceeding 30 feet in depth was excavated below the curb of a well, sunk through clay, without producing any movement in the well even though dynamite was used to assist it. The hole was filled with sand, and a diver was sent to investigate whether the curb had met with any obstruction. Nothing was found. On dredging being resumed the well commenced to move downwards.

THE BASSEIN

The bridges on the Bassein River in western India are also noteworthy. The north and south Bassein bridges jointly are one and a quarter mile in length and of the two, the bridge at Broach is one of the longest single bridges with deep-well type foundations.

THE HOOGHLY

Bridging the Hooghly continued for many years to be one of the most complicated

and baffling problems confronting railway engineers. From the very initial stages several schemes were considered for constructing a railway bridge to connect Howrah with Calcutta. A very early attempt to build a bridge over the Hooghly was made in the late forties of the last century at a place called Govindpur, near Calcutta. Unfortunately, soon after the bridge was completed the entire structure collapsed. In 1875, a pontoon bridge was completed between Calcutta and Howrah, but only to carry vehicular traffic. The pontoon bridge was finally demolished in 1945 and in its place was constructed a single span cantilever type multipurpose suspension bridge for road traffic, which today ranks among some of the finest bridges of the world.

In 1887 the first railway bridge was built over the Hooghly River, but at a point 28 miles from Howrah. This magnificent structure still stands bearing testimony to the ingenuity, skill and resourcefulness of railway engineers of the time. The actual work on the bridge was begun in 1883. The bridge is approached from both sides by masonry viaducts of 3,278 feet and 441 feet respectively consisting of 141 brick arches of spans varying from 10 to 48 feet. The total length of the bridge proper is 1,213 feet. The length of the entire structure is approximately a mile. The bridge was originally constructed for a double line of railway, but as the present day moving dimensions do not permit double line traffic on the bridge, the tracks have been interlaced on the bridge to pass trains as a single line. At the site of the bridge the Hooghly channel is 1,200 feet wide, being the narrowest over several miles up to Calcutta. In places the bed is 66 feet deep below mean sea level, and the height of the tide varies from a little below mean sea level to 20 feet above, with a maximum velocity of four and a half miles an hour on the ebb tide in freshets. The river is largely used for navigation, and provision had to be made for allowing big country sailing boats, inland steamers and flats of 500 to 600 ton capacity to pass under the bridge. The bridge provides for two large openings each of 525 feet clear span, with a central smaller opening of 106 feet 6 inches between two piers, supporting a span of central cantilever girders. The central girder section of 360 feet is carried on two piers placed only 120 feet 6 inches apart from centre to centre. Resting on the overhanging projecting end of the central cantilever girders, the two land girders each 420 feet long stretch to the bank abutments. The object of this somewhat unusual arrangement giving two very wide land spans and a small one in the centre was partly to locate the piers in comparatively shallow water and partly to leave the widest opening on each land side for navigation.

Some very unusual methods had to be adopted in the construction of the bridge. The girders of the land spans for example, were each erected on lines of rails carried on the surface of the two approaching viaducts. A complete span,

composed of two connected girders weighing 1,000 tons, was then mounted on rails, and the whole mass was run forward by the aid of steam tackle, until the outer end of the girders projected over the water for some distance beyond the face line of the abutment. At this stage two floating pontoons fitted with a suitable staging were brought into position beneath the projecting ends of the girders which were wedged in and supported on the pontoon staging. The pontoons were them moved across with the current, until the ends were brought into position and deposited on the projecting extremities of the cantilever girders. All these operations of extraordinary magnitude and difficulty required the most exact calculations, ingenious adaptation of basic principles to local conditions, and utmost precision and timing. The total cost of the bridge inclusive of the approaching viaducts came to nearly Rs 39 lakhs.

Belonging to a much later date of construction (1927-29), the Willingdon Bridge which spans the Hooghly at Bally was by far the most expensive and the most difficult of the railway bridges to be constructed in India. The bridge was constructed at a total cost of Rs 1,14,67,000. At the point where this spectacular structure crosses the River Hoogly is 2,520 feet wide. The viaduct at Bally consists of 22 spans of 30 feet girders built of masonry piers, whose foundations have been piled with reinforced concrete piles 40 to 50 feet long. The bridge itself consists of seven 350 feet main spans and two 80 feet land spans. The eight main piers in the river are founded on octagonal steel caissons, 70 feet by 37 feet, having two dredging holes each 19 feet in diameter. The caissons were all floated into position and founded by loading with concrete, sustaining the load on compressed air buoyancy and releasing the air on a suitable falling tide. A detail in the erection, unusual in bridge building, was the method of putting camber into the girders. Instead of building the bottom boom with the required camber in the first instance, as is usually done, the bottom boom of the Bally bridge girders was erected level on the cross girders, and then the ends of the boom were dropped four inches. Another extraordinary feature of the bridge which makes it virtually unique in the world is that the caissons (70 feet by 37 feet) have been sunk in a tidal river in four feet of water, with a current at times six miles an hour. It may be mentioned that at periodic intervals the Hooghly River is visited by tidal ' bores ' which are known to overturn heavy boats, tear steamers from their anchors, and even pull away floating docks from their moorings. They have been the nightmare of all bridge builders and of everyone connected with navigational work in the Hooghly River. Provision had to be made for these tidal ' bores ' as well.

THE TISTA

The Tista Bridge is another remarkable instance of bridge building on the Assam

Above : Beas Bridge, opened 1869, Northern Railway.

Above : The old Chambal Bridge near Dholpur, Central Railway.

Below : The new Chambal Bridge, regirdered in 1934.

Above : Kali-Sindh Bridge on the Bhopal-Ujjain Section Central Railway-Observe the Steel Trestle piers.

Left : Ehegaon Viaduct across on deep gorge in the Western Ghats, Central Railway.

Below : The regirdering of the Ehegaon Viaduct, Central Railway in progress.

Above : A double decker train passing over a diversion on the Narbada Bridge, 1876, Western Railway.

Below : A view showing a train passing over the old south Bassein Bridge opee dnon 28th November 1864, Western Railway.

Below : Krishna Bridge, Southern Railway.

Below : Dorabhai Viaduct at Chelama, west view, Southern Railway.

Above : Reond Bridge on the Kangra Valley Section of the Northern Railway—the only steel arch Railway Bridge in India.

Below : Byculla Bridge, Bombay.

Below : Silver Jubilee Bridge over the Narbada River at Broach, on the Western Railway.

Rail Link. Rising in glacial heights and fed by snow streams, the river flows through a gorge before it debouches into the plains just above the bridge site at Sivok.

The river had changed its course several times in the past. In 1948, the design of the spans originally planned had to be altered owing to a change in the river-bed, and it was decided to built a bridge of four spans of 150 feet with a central span of 250 feet. The wells as well as the piers were built in cement concrete. The bed of the river was full of boulders up to four feet diameter, and therefore, the wells had to be sunk by the pneumatic process. The sinking of wells and the construction of piers was completed just before the monsoon.

The members for the 250 feet girder were brought to the site of the work by the end of February 1949. As the girder could not be end-launched, it had to be assembled on an island in the bed of the river slewed to come alongside the span and raised on top of the piers before the floods which were expected any time after March. The odds were heavy on both sides, *viz.*, if the girder was not erected in time and floods came, it would be washed away and replacement of this girder would take another year, whereas if the erection was not done before the 1949 monsoon, the bridge could not be opened in January 1950. The risk was taken and through the excellent work of all concerned, the girder was erected and taken on top of the piers just two days before the floods came. The 150 feet girders were all erected on the right bank and end-launched one by one from this bank with an assisting 150 feet span temporarily connected at the back of the span to be launched. All girder erections were completed on 25th June 1949 when the river was in high flood. A guide bund with concrete-block apron and boulder-pitched slope was built on the left bank to train the river through the bridge. The bridge was opened for goods traffic on 9th December 1949.

The Tista which was estimated to take a discharge of two and a half lakh cusecs, brought in, as a result of exceptionally heavy rainfall, a discharge of about six lakh cusecs and, in the early hours of 12th June 1950, the flood over-topped the left guide bund and caused a breach of 750 feet in the embankment at the back of the east abutment and 80 feet at the back on the west. Dislocation to this vital line of communication could not be allowed to remain indefinitely. Incessant day and night work by the staff of the Assam Rail Link through heavy monsoon and floods enabled restoration of the line of communication on 2nd August 1950. The pile bridge in the east approach was built on a division 30 feet away from the centre-line of the permanent bridge so that, in case it was decided to extend the permanent bridge, necessary working room would be available.

The design of the waterway for this bridge was thoroughly investigated by the Central Water Power, Irrigation and Navigation Commission, and on their recommendations the extension of the bridge by adding 3×150 feet spans on the

east was ordered. The bridge was finally completed after constructing these three additional spans of 150 feet on the east end, *i.e.*, with spans of 2×150 feet, 1×250 feet and 5×150 feet spans, and a guide bund was provided on the east bank for guiding the water through the bridge. The bridge was reopened for passenger traffic on 24th February 1951.

Such briefly have been the achievements of railway engineers who were confronted with the task of spanning one of the most complicated network of waterways in the world, consisting of rivers of indeterminate dimensions with tricky subsoil, passing through areas varying considerably in altitude and strata, and presenting numerous and perplexing problems. The achievements of these engineers may not have been unique in so far as the dimensions of the bridges were concerned, but taken as a whole, were certainly spectacular and magnificent, and, in many respects singular in the history of railway construction in the world.

IX. Pride in Architecture

During the early days of railways, little attention was paid to what have now become, in some cases, architectural wonders: the railway stations. The earliest of these in England, Germany, America and in most other countries were no more than unimpressive sheds providing a 'landing' place for incoming trains. The sheds were intended to offer shelter from the weather. A remnant of these earlier structures in Britain was preserved till 1937: a railway station in Wales consisting of nothing more than a large semi-circular arbour of closely twined trees 'which in summer offers shade and shelter from the wind and the rain, and in the winter does not.' Early railway stations, according to Osborne, recalled in some respects sea-side landing places 'a necessary but very temporary convenience from which the passengers hurry as soon as possible.'

Railways soon became prestige conscious. By the forties railway stations had become a thing of enormous pride and importance. All over England rose buildings as impressive in dimensions as they were artistic in architectural design. In London were Euston a Grecian-Ionic structure, St. Pancras with its hundreds of highly decorative pseudo-Gothic windows, Paddington, looking like a palace and representing a mixture of Italian and Arabesque architecture, and Charing Cross built in a simple but charming classical renaissance tradition. Milan has still the largest railway station in the world covering an area of 103 acres. In the United States, railway stations have not only introduced novelty of design, bearing the impress of an utilitarian age, but are in grandeur and magnificence, outstanding achievements of modern times. Railway stations in such cities as New York, Chicago, Philadelphia, Washington and San Francisco, have been built under and over ground. They have colossal concourse and waiting halls, restaurants, arcades, cinemas, theatres, stairways, lifts, escalators and a maze of subterranean passages leading to distant openings into streets, all representing a multipurpose utility, unknown in any other part of the world.

In India station buildings vary. Some are no more than a collection of old wagons and coaches, while there are others as outstanding in architectural design,

as magnificent in construction and as well provided in ordinary amenities for passengers, as anywhere in the world.

The average railway station in India consists of a large brick structure providing accommodation for offices, and a waiting hall for passengers. In addition, according to the importance of the station or the pressure of passenger traffic, provision is made for separate waiting rooms for passengers of various classes, and for men and women, and for refreshment rooms and restaurants. The platforms, covered or uncovered, vary in number and in dimensions. Separate station offices, platforms, and sheds are generally provided to deal with goods traffic. Over-bridges and sometimes underground sub-ways enable passengers to cross from one platform to the other.

PLATFORMS

While such is the basic pattern of railway stations all over the country, the size of stations varies considerably. The covered buildings and sheds in many cases, especially at junction station, and stations located in moderately big cities, extend to an area of four to a dozen acres. Some of the stations at places of pilgrimage, though structurally fairly modest, have a total length of covered and uncovered platforms of half a mile or more. On the seven railway stations in the world having the longest railway platforms, as many as five are in India, being Sonepur with the longest platform in the world (2,415 feet), Kharagpur (2,350 feet), Lucknow (2,250 feet), Bezwada (2,100 feet), and Jhansi (2,025).

The utilitarian pattern is common to a large number of railway stations in India, but there are several whose structural beauty, architectural design and general layout make them outstanding.

VICTORIA TERMINUS

Among the best, and also one of the very early ones to be built, is the Victoria Terminus in Bombay, at Bori Bunder. It derives its name from Queen Victoria because the station building was formally opened on Jubilee Day in 1887. Before 1852 when its first pier was constructed, Bori Bunder in Bombay was just a landing place for country boats. The first station at Bori Bunder was ' a miserable wooden structure.' Most of the upper class passengers boarded trains from Byculla which had a pretentious platform and an attractively-built shed. Originally Victoria Terminus was intended to accommodate only the offices and the main station. Since 1887, additional buildings at adjoining sites have been erected. The annexed building was used as a hopital during the 1914-18 World War, and is now used for offices. The new station building was opened in 1929, to deal with the main line traffic. The additions were so designed as to harmonise with the architectural magnificence of the 1887 building, and to create an impressive

Above : Victoria Terminus and Central Railway Headquarters, Bombay.

Below : Western Railway Headquarters, Churchgate, Bombay.

Above : General Offices, ex-South Indian Railway, Trichinopoly

Left : Bengal Nagpur Railway Headquarters, Garden Reach, Calcutta.

Right : Southern Railway Headquarters, [Madras.

Right : Eastern Railway Headquarters, Fairlie Place Calcutta.

Below : Traffic outside Howrah Station.

Above right : Traffic outside Howrah Station.

Right : The new Sealdah Railway Station.

Below : The old Sealdah Railway Station—1862.

Above : Central Station, Madras.

Above : Trichinopoly Junction.

Below : The new Baroda Railway Station.

Below : The old Baroda Railway Station.

composite effect. The old and the new stations together comprise one of the largest and busiest station terminals anywhere in the world.

The site on which Victoria Terminus is located is of great historical importance, being associated with the very origin of Bombay as a city. Recent researches into old records show that Bombay derived its name originally from the Goddess Mumba Devi, or Maha Amba. The earliest temple dedicated to her is believed to have stood at the very place where Victoria Terminus was erected in 1887. The original shrine, was demolished by Mubarak Shah, better known as Qutab-Ud-Din, and was re-erected in 1317. It was again demolished in 1760 by the Portuguese. The tank adjoining the shrine continued to be preserved till 1805. A public gibbet or gallows was constructed by the Portuguese at the site of the tank, from whence the site and the tank derive the name Gibbet Pond.

Designed by the famous architect, F. W. Stevens in 1887, Victoria Terminus is Gothic-Saracenic in style, with a series of well proportioned and delicately-ornamented arches, giving it the look of a grand cathedral. This effect is further heightened by a central dome set off by a number of smaller domes and conical towers reminicent of Westminster Abbey. The lancet windows in the dome and towers are of ornate-stained glass, and like the rest of the building, are made out of solid cut-stone masonry, superimposed by delicate artistic work, designed in plaster. The apex of the dome is crowned by a colossal figure in stone symbolising 'progress.' This figure is 16 feet 6 inches in height. On the principal gables are displayed sculptural panels representing 'Engineering,' 'Agriculture,' 'Commerce,' 'Science' and 'Trade.' The arches and the windows are venetian in style and overlook a 1,500-feet facade. The double columns which support the arches of the verandahs and the colonnades are of marble. Italian granite has been freely used for interior decoration. The old station has eight platforms, while the new Main Line Station, which is separated from the Old Station by a wide road, consists of five passenger platforms, and one platform for parcel traffic. Both stations have waiting halls, station masters' offices, booking offices and book-stalls. In addition, the New Station building contains a post and telegraph office, reservation and enquiry offices, retiring rooms, restaurants and cloak and check rooms. Part of the buildings are also occupied by the administrative offices of the Central Railway.

HOWRAH

Overlooking the banks of the Hooghly, the Howrah railway station, constructed in colourful red brick, dating back in its present form to 1906, may not be as magnificent in architectural design as Victoria Terminus, but is certainly a very imposing structure. Dimensionally, it is larger than any station in India. The site now occupied by the Howrah railway station originally belonged to a

missionary orphanage run by Portuguese Dominicans, by the side of which was located a small church. During the early part of the 19th century as a result of an epidemic, the orphanage was shifted to Calcutta. The site was later sold to the East Indian Railway.

More utilitarian in style than ornamental, Howrah has a large concourse opening into the various platforms on the one side, and surrounded on all others by offices, retiring rooms and waiting halls. Something which gives Howrah station special importance, is the variety and amount of traffic it attracts. There is no station in the world where so many vehicles of such variety—public buses, trams, motor cars, horse carriages, bullock carts, push carts, ordinary rickshaws and bicycles—can be seen plying back and forth at all times of the day and night.

There still exists a bronze plate in the Divisional Office building at Howrah which bears the number zero. This originally indicated the first milestone of the track of broad gauge to Hooghly. The Divisional Office itself, a three-storeyed building, was then a modest building of red brick with a roof of corrugated iron sheets. This was the original Howrah station. Running perpendicular to the Hooghly River on the two sides of the building are two platforms. A track runs in front of one of the platforms while the other is used as a landing place for goods. The former which now only receives parcel trains, is indicated as number twelve. There are besides eleven other platforms providing for 60 trains which arrive at and leave Howrah station every day.

SEALDAH

Though not as large, but certainly with architectural features of great elegance, is the Sealdah station located a few miles from Howrah on the other side of the Hooghly and virtually in the heart of Calcutta. Built in a distinctly Italian style with touches of oriental architecture, Sealdah station is imposing in design and utilitarian in construction. It has perhaps the longest covered platforms, two of them being a little less than 1,000 feet each in length, and over 28 feet wide, with covering sheds 550 feet in length, and extending over six lines of rails. The upper part of the roofing of this magnificent building is of typical indigenous construction and hence is of extraordinary architectural interest. It is covered by what is called 'Khoa roofing.' 'Khoa' is composed solely of broken bricks of varying coarseness, mixed with sylhet lime deposited in several layers, the finest layers being placed uppermost. With the aid of plenty of water the entire mass is beaten into shape by wooden mallets. Owing to numerous deep water tanks that have had to be excavated the foundations of the building in several places are as far as 45 feet below ground level, and some of the separating walls at this level are eight to ten feet thick. To enable trains to approach the station at a high level, a six-mile long embankment has had to be constructed. Half a mile from the

platform is a fine steel girder bridge with three 110-feet spans erected over the circular canal. The station concourse is 200 feet long, 40 feet high and 40 feet wide. In the building itself several ingenious devices have been introduced for ventilation and lightning, and also to prevent the flooding of the building by heavy rains.

LOCAL TOUCH

There is something very distinctively indigenous and yet modern about the stations at Lucknow and Kanpur built in 1926 and 1928 respectively. The several domes and towers are of Indo-Saracen design intended to harmonise with the architecture peculiar to some of the important historical buildings in Lucknow, and dating back to the days of the Nawabs of Oudh. The buildings constructed in red brick have a long facade of wide verandahs adorned with Moghul arches. A central portico leads to a spacious loggia, on both sides of which on two floors are administrative offices, refreshment rooms, waiting halls and retiring rooms. Constructed along the length of the station, and approached by over-bridges and sub-ways, are a number of platforms running into enormous lengths for receiving incoming and outgoing traffic.

Railway stations in Rajputana, at Jaipur, Jodhpur, Ajmer, Ratlam, Udaipur, etc., have a distinctly Rajput motif. Similarly, there is something typically Deccanese about stations at Hyderabad and Secunderabad. It would be difficult to classify the structural design of stations at some important places like Delhi, Amritsar, Patna, Gaya, Banaras, Allahabad, Nagpur, Madras, Erode, Trichinopoly, etc., but their utilitarian pattern presents a rich variety in motif and design. The stations on the various hill railways are of exotic shape and form, with a sort of rough simplicity, in harmony with the rocky setting. The railway stations at Simla, Solan, Dharampore, Ootacamund, Kurseong, etc., with their sloping roofs, look like cottages transplanted from the Alpine regions.

BOMBAY CENTRAL

The Bombay Central station built at a cost of one and a half crores of rupees in 1930 typifies perhaps more than any other structure, constructed in recent times, the spirit of the utilitarian age. It is by far the most modern building of its kind in India, if not in the whole East. With wide approaches the main facade, which is well away from the road, is impressively set off by a massive 65 feet concrete arch and a wide portico of equal length. The main concourse is 260 feet in length and 120 feet in width. Its roof supports are carried on decorated lattice stanchions very much on the same line as those in the Pensylvania Terminal in New York. Its area, together with a second concourse, forms a total of some 74,000 square feet. The height from the concourse floor to the apex of the roof

is 70 feet. Lighting is by means of ten clear storey windows in dormers cut into the main roof on both the northern and southern sides. The exterior of the main building is faced in pre-cast cement concrete 'Ashlar' masonry. In the south wing covering some 12,000 square feet, are situated the station master's office, general waiting rooms, etc. On the second floor above the main entrance are sets of retiring rooms, comfortably furnished and complete with lavatories and bathrooms covering an area of nearly 7,000 square feet. The covered area of both the train sheds is nearly 1,50,000 square feet, and the longest platform is over 1,000 feet in length.

Above Egmore Railway Station, Madras.

Above : Delhi Railway Station.

Below: Northern Railway Headquarters, Baroda House, New Delhi.

Below : A view of the old Surat Railway Station.

Below : Front elevation of the Surat Railway Station (1952).

Above : Jodhpur Railway Station.

Left : Lucknow Railway Station.

Below : Khargpur Railway Station.

Above : Colaba Station, the old terminus of the Bombay, Baroda and Central India Railway, prior to the opening of Bombay Central on 18th December 1930 as the new terminus station built in 1893.

Above right : Built in 1876, old Churchgate station as it was prior to the remodelling done in 1928.

Right : Ranchi Railway Station.

Below : Siliguri Railway Station.

Above : Bilaspur Railway Station.

Below : Simla Railway Station.

X. Permanent Way and Signals

It is difficult for people to imagine that even before the railway age, devices for the moving of vehicles over parallel constructions of wood or stone were being employed, and that the principle of moving heavy vehicles on rails played a much more important part in the development of railways than the invention of the steam engine. In fact, as the very name suggests, from the very time that 'the wheels of trucks and vehicles that used parallel courses of wood or stone were flanged, "Railways" existed.' The first to employ this principle were the Romans. There still exist the remains of some of the early Roman roads with two parallel brick work alignments intended for the free moving of the wheels of animal-drawn vehicles.

Since the early 15th century, wooden rails were being employed in England and some other parts of Europe, for the movement of horse-drawn trucks. These trucks in England came to be known as 'tramways,' since one unit load of timber was then referred to as a 'tram.' There are records of these 'tramways' and 'wagon-ways' in 1660 in the neighbourhood of Newcastle-on-Tyne and again on Tyneside. It was in 1767, according to available records, that wooden rails started being replaced by cast iron ones.

From the beginning of the 19th century, these 'Rail-ways' for trucks and trams drawn by horses were a common sight in various parts of England and some parts of the continent. In 1801, a short horse rail-road was working in England, between Wandsworth and Croydon.

In 1804, Trevithick discovered that trucks could be propelled more easily 'by the adhesion of a smooth wheel to a smooth rail.' This perhaps more than anything else, paved the way to the use of the moving steam engine, pulling behind a number of coaches or wagons. The fact that a large number of coaches pulled by a locomotive move smoothly and safely and at a very rapid speed seems something easy, natural and commonplace to people today. But to earlier engineers, even after the principles of moving wheels on rails and of the propelling power of steam had become known, the building up of a track, capable of bearing the pressure of heavy fast-moving trains, the construction of rails, the determining

of the distance at which they should be affixed parallel to each other, and the manner of fixing them to ensure firmness and stability, presented some very difficult and complicated problems. These problems have continued to be the subject of research up to today. In fact, in the early stages it was difficult to convince people that a fast-moving railway train would continue on its tracks and was not likely to run off the rails and become a danger to the life and property of those living in the neighbourhood of the railway line. So widespread was the fear, that some of the counties actually made representations against railway tracks being built through their territories. To obviate some of the dangers of trains going off the tracks, various alternative inventions were tried which in the light of the experience of the past hundred years might seem amusing and grotesque.

In England, an inventor by the name of Lewin, introduced what was then known as the 'Atmospheric System.' This was based on the 'general principle that trains should be propelled forward by means of atmospheric pressure acting on a piston working in a tube from which the air had been pumped by stationary engines situated at intervals along the line of route.' The system was not a passing fancy. It was actually tried at many places, and even an Act of Parliament was passed authorising the construction of an Atmospheric Railway from Croydon to Epsom. Another inventor, Mr Parkins, constructed an apparatus by which the train was run by a stationary engine hauling a rope wound round a large wheel on the carriage. To the same inventive period belong the Kollmans engine and carriages with no flanges to the wheels, but which were kept on the rails by means of horizontal wheels fixed to movable angles and run on a supplementary central rail.

During the eighteen forties when various schemes for developing railways in India were being discussed, a book written by a Colonel Grant of the Bombay Engineers attracted great attention. In view of 'high mountains, impassable rivers, thick forests and jungles, and herds of cattle and other animals found moving about all over the country, he felt that the idea of laying the permanent way of railways on the surface of the ground was utterly inapplicable under the conditions and circumstances of India.' He recommended that every Indian Railway should be suspended throughout its entire length by regular series of suspension chains, at a minimum height of eight feet above the ground, which he considered would be ample to place it beyond the reach of animals and to find fairly uniform alignment. Costly models of this extraordinary system of railways were even prepared and exhibited. Several other schemes of an equally ingenious and erratic character were advocated and rejected before the existing system, whereby parallel iron rails are laid over a specially prepared track of ballast and fastened to sleepers either of timber or iron to hold the rails into position, was adopted.

SLEEPERS

In India, sleepers are placed at a certain distance apart at right angles to the rails. In some other countries they are placed longitudinally in a continuous line under the rails. Longitudinal sleepers are still considered safe and economical on lines of wide gauge as in some parts of Russia. According to some experts ' rails laid on them make a very easy and smooth road.' The arrangement has been rejected as impracticable in most countries. In India, both timber sleepers and cast iron bowls, or as they are called ' Pot ' sleepers have been freely in use.

What may seem very simple, but something which has led to great divergence of views, involving equally great diversity in application, is the final determination of the distance at which the two parallel rails should be affixed from each other. The track distance in various countries and between railway lines in the same country has continued to differ very widely. This distance is termed as the ' gauge ' of a railway.

THE GAUGE

India along with Spain, Portugal, Brazil and Chile adopted the five feet six inches gauge for all the earlier main lines, and a metre gauge or a three feet three and three-eighth inches gauge for the less important main lines and feeder lines. The standard gauge of railways in England is four feet eight and half inches, but a few lines of narrow gauge occur in the hilly districts of Wales. Originally the Great Western Railway in the United Kingdom was constructed on a gauge of seven feet, but finally the standard gauge was adopted. In the United States gauges vary between four feet and eight and half inches and three feet, the English standard gauge being the most popular. While variations are most common in Australia, Japan, Tasmania and to a great extent Norway, the three feet six inch gauge is fairly standard.

In the course of his famous minute written in the early part of 1853, Lord Dalhousie, the then Governor-General of India, after having received the reports and opinions of various consulting engineers and railway experts in the country, recommended that the gauge should be five feet six inches. This gauge was adopted for all the main lines. Considerations of economy, however, weighed heavily with Lord Mayo, who as Governor-General in 1870, in an equally strong and powerfully reasoned note recommended that some of the new branch and feeder lines should adopt a gauge of three feet three and three-eighth inches, which came to be known as the metre gauge. This gauge afforded a much needed means of communication to poorly-populated and backward districts, since it could be built more cheaply, mile for mile, than the broad gauge. Different gauges have since been adopted in India to suit the exigencies of the occasion, or the requirements of traffic. Today there are in India some 16,000

miles of broad gauge, 15,000 miles of metre gauge, and 3,000 miles of narrow gauge lines.

Whether at any stage in the near future India will be able to adopt a single uniform gauge is difficult to prophesy. Taking into account the mileages already laid to different gauges, the trend would seem to lie in favour of working two main gauges—the broad gauge (five feet six inches) and the metre gauge (three feet three and three-eighth inches) with short hill railways of narrow gauge *e.g.*, Kalka - Simla, Darjeeling - Himalayan and Nilgiri Railways. This would avoid wasteful diversity in form, size and shape, and types of locomotives, carriages and wagons, and the necessity for transhipment of goods and passengers at a number of junction stations on account of change of gauge.

RAILS

The standard of rails is expressed in terms of weight in pounds per yard. The broad gauge train line tracks have a 90-lb standard and the metre gauge standard is 50-60 lb. The Indian standard rails are of the flat-footed type though there are still several miles of older type bull-headed and double-headed rails.

The length of rails varies usually from 30 feet in branch lines to 42 feet in the main lines. The joints between rails are 'fished,' the term being derived from nautical parlance. Two plates, called fishplates, are placed on either side at the joint of the rails to be joined and these fishplates are clamped together by fishbolts passing through holes in the fishplates and the web of the rails. A small gap is left between the two rails, called the expansion gap, to permit the rails to expand and contract with variations in temperature.

Accidents involving loss of life have been caused by saboteurs removing the fishplates and moving the rail ends slightly to put them out of alignment with one another. Several devices to make it more difficult to tamper with rail joints have been tried and the latest is welding the joints to eliminate fishplates at particularly vulnerable locations *e.g.*, at major bridges.

EARLY SIGNALS

Signalling and Interlocking have developed during the years very considerably and today are the keys to safe, speedy and efficient running of trains.

The first railway train which left Darlington for Stockton did not have the benefit of signals. It was preceded by a couple of policemen riding on horses to clear the way. A few years later policemen in impressive uniform were stationed at intervals all long the line to regulate the slow moving traffic. The semaphore is supposed to be no more than the arm of a traffic policeman.

Tradition has it, that the first fixed signal ever used in the world was a candle fixed to the station master's table at Hartlepool in England. This soon gave place

Above : Main signals at crossing station as used in the early stages of signalling.

Above : Cabin lever frame provided at cabin interlocked stations on the Indian Railways.

Left : Train despatcher controlling signals at a busy Junction on the Northern Railway. The Block instrument on the left of the train despatcher is for control of train on double lines

Below : A view of Reception Signals at Adra Junction, Eastern Railway.

17·5 cm 100 zinl

Above left : A signal lowered for the engine to return to Shed.

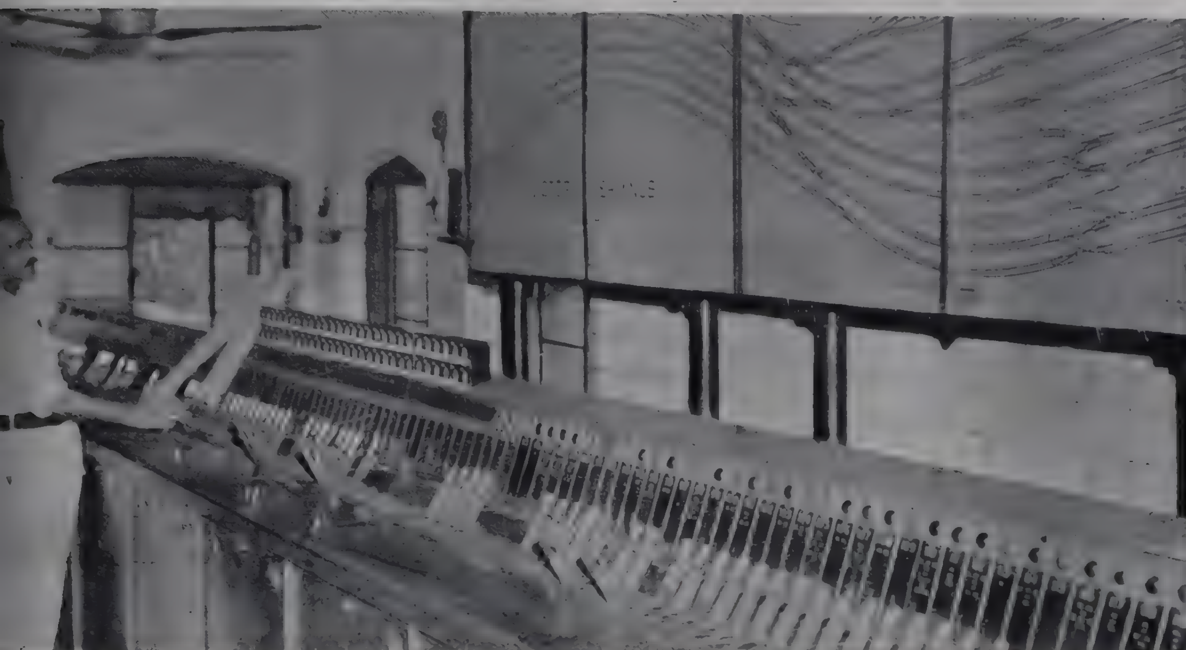
Above right : Co-acting starter signals operated by Double Wire.

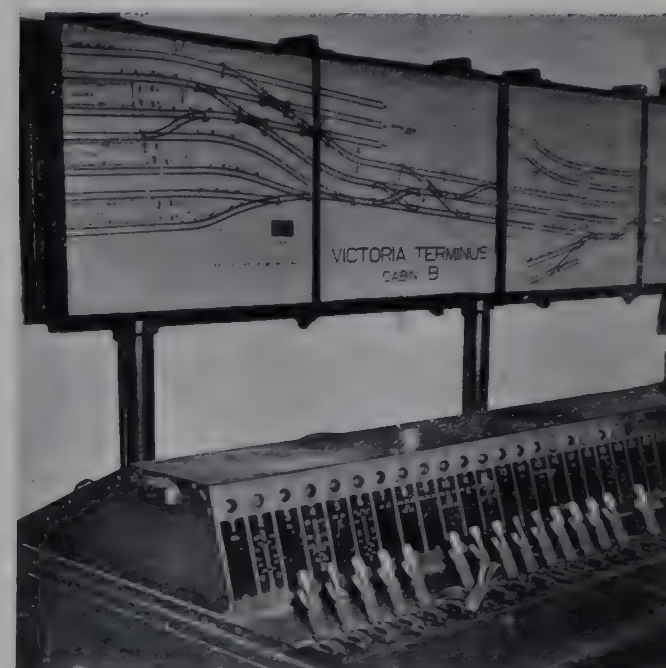
Extreme left : Upper Quadrant Three Aspect Signal operated by Double Wire. Such signals are provided quite extensively on North Eastern and Southern Railways. The picture shows Distant in the 'OFF' position.

Left : Upper Quadrant Three Aspect Signal operated by Double Wire. The Stop signal is in the 'Caution' position.

Below left : Double Wire Lever Frame at Ondal, Eastern Railway.

Below right : View of a modern cabin on the Northern Railway.





Top left : View of colourlight signals at Delhi on Northern Railway.

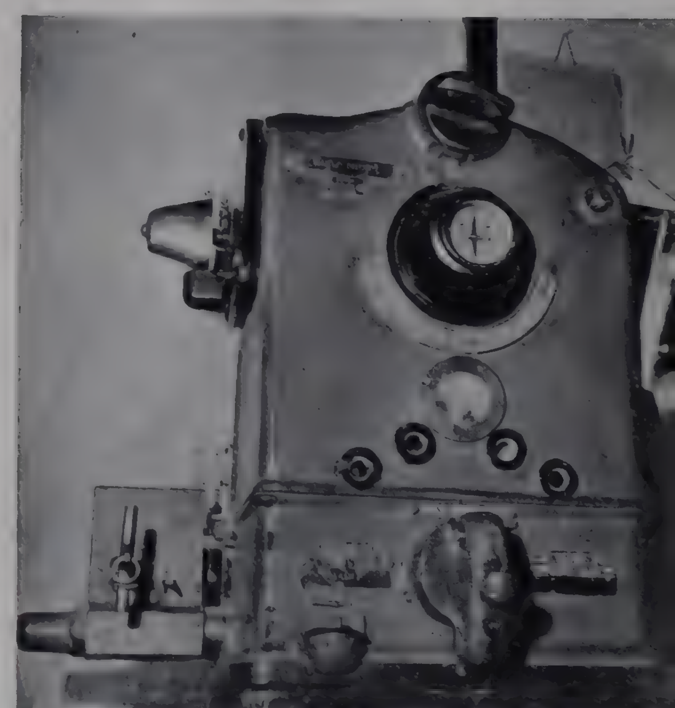
Top right : Facing points operated by electric points machines. The use of these motors makes operation of facing points at any distance possible with no effort.

Above left : A view of Power Frames at Bombay V. T.

Above right : Another view of Power Frames at Bombay V. T.

Right : Neale's Token Block Instrument used popularly on busy single line sections.

Below : Howrah Yard.



Above left : V. T. Railway Yard. *Above right* : Thana Yard.
Below : A view of the Yard, Adra, B. N. Railway

Above : A view of the Howrah Yard.

Below Left and *right* : Sandhurst Road Gradient.

to the disc and cross bar signals. In India, in the early years of railways, the signals consisted of either revolving discs or arms with separate spectacles for lights. There was then not much interlocking between the points and signals. The signals, which were commonly provided at wayside stations, consisted of only 'main signals' fitted in front of the station master's office and an outer signal in each direction, without any interlocking between the facing points and signals. Later, semaphore signals with combined spectacles were introduced and the station yards were key interlocked, keys being transmitted by hand.

There was no standard signalling system in India until 1892, when Mr G. H. List, commenced his pioneer work on Indian interlocking by bringing into service his patent 'simple' apparatus at six single line crossing stations on the North Western Railway. This took the form of a detector locking apparatus for protecting the facing points used by trains running through the station at speed. By 1894, in collaboration with Mr A. Morse, he had installed his much improved interlocking apparatus under the name of the 'List and Morse' system at 28 single line crossing stations between Lahore and Ghaziabad. Although now obsolete, the 'List and Morse' system is still in existence at a number of stations on the Indian Railways and 'List and Morse' have earned a place for themselves in India as 'the fathers of Indian Signalling.'

Until 1904, transmission of keys used for key interlocking was by hand. This was found to impede traffic. To avoid these delays, electric key transmitters were invented by Major (later Sir Lawless) Hepper, Signal Engineer, ex-North Western Railway, who eventually became General Manager of the ex-Great Indian Peninsula Railway. These key transmitters, popularly called 'Hepper's Key Transmitters,' have been used very extensively on the Indian Railways.

Until the turn of the 20th century, signalling was installed and maintained by the engineering department. The first railway to appoint a special officer as signal engineer was the ex-East Indian Railway, who appointed Mr S. T. Dutton in 1889. The Great Indian Peninsula was the second railway, who appointed Mr I. W. Stokes, in 1903, and this was soon followed by the other railways. With the growth of further traffic, the system of 'Cabin Interlocking,' as invented by John Saxby and existing on British railways, was adopted. Some of these cabin interlocking schemes were designed and installed by Messrs Saxby and Farmer (India) as early as 1893. As the speeds of trains and density of traffic increased, the imperative necessity for a suitable system of signalling and interlocking to ensure safety and to deal with traffic expeditiously was then recognised. The ex-Great Indian Peninsula Railway was the first railway to have installed cabin interlocking on a large scale on their Bombay—Delhi route. This was finally completed and opened in 1912. Similar cabin interlocking was then adopted by other railways on their major routes.

SUBSEQUENT DEVELOPMENTS

During the past 30 years, developments in the field of signalling and interlocking and telecommunication have been both rapid and considerable. Indian Railways have kept themselves fairly abreast of the times and have not been slow in introducing the latest methods and devices *e.g.*, track circuiting, power and automatic signalling, double wire operation of points and signals, automatic train control etc. All that has been developed in the way of modern signalling, has resulted in much greater efficiency of traffic operation. Greater number of trains can now be run under conditions of greater safety at higher speeds over the smallest number of tracks at minimum cost.

Telecommunication is being increasingly used on railways as a truer appreciation of its worth is becoming more widespread. Developments in this sphere have been very considerable involving all the latest in apparatus and design *e.g.*, telephone train control, teleprinters and wireless.

Recently, the Railway Ministry have completed a major step forward in the amalgamation of signalling and telecommunication branches, thus forming a unified single department dealing directly with these closely associated subjects of growing importance.

AUTOMATIC SIGNALLING

It was in the early 20th century that 'Track-Circuiting' was invented and was in due course adopted at some of the important railway stations in India. 'Track-Circuiting' indicates electrically the condition of any required portion of track, as to whether, it is 'occupied' or 'clear.' It is also used for providing desired controls on the operation of points and signals. The working of points and signals can be made dependent upon the track concerned being actually 'occupied' or 'clear,' eliminating the human element. A new field of providing increased safety in train working was thus opened and 'Track-Circuiting' was introduced at some of the very busy stations. It was also in the early 20th century that 'Power Signalling' was invented, which enabled points and signals to be operated from small levers in a central frame, electrically or electro-pneumatically. 'Power Signalling' when installed in conjunction with 'Track-Circuiting,' enables heavy traffic to be handled expeditiously and safely. This is installed at some of the busy stations such as Bombay, Calcutta and Madras and the adjoining areas.

Automatic signalling has also been installed to provide increased traffic capacity on sections and close headway for trains on many double line sections. On some of these, in rush periods, trains are allowed to follow after every two or three minutes. The use of automatic signalling has increased traffic capacity of many existing sections, saving heavy expenditure which would have otherwise been involved in the construction of additional tracks.

The signals used in power and automatic signalled areas are mostly 'colourlight,' which provide a very good indication to drivers both by day and night, and are efficient and modern.

DOUBLE WIRE SIGNALLING

Double wire operation of points and signals, as distinct from the single wire operation for signals only, has been developed on the Indian Railways for working points and signals by means of signal steel wires. By this system, signals operate more positively and efficiently and there is less risk of signals 'drooping.' Points can also be operated at much greater distance than by rodding, enabling a wayside station to be operated directly from a central frame. Double wire signalling may either operate two aspect or multiple aspect signals. The signals can be made to display aspects as required, indicating, 'stop' or 'attention' or 'caution' or 'clear.' This provides increased safety on sections where speeds are high. Double Wire Multiple Aspect Upper Quadrant signalling has, therefore, been introduced on several sections. This was first developed by Mr E. W. Baker, Signal Engineer, ex-Assam Bengal Railway, and a large number of Double wire installations were introduced on the Southern and North Eastern Railways. Many more are now being installed on other railways.

BLOCK WORKING

In the early years of railways working of trains between stations was under 'Paper Line Clear.' But during the last 30 years 'Paper Line Clear' has been progressively replaced with Block Instruments on all important single and double line sections.

Under the system of working trains (called the Absolute Block System) no train should leave a station unless permission to do so has been obtained from the receiving station. Such permission should not be given unless the section between two stations (called the Block Section) is clear. Originally this permission was obtained on the Morse Telegraph Instrument and issued to the driver on a ticket called the 'Paper Line Clear Ticket.' Block Instruments were later evolved which helped to comply with the requirements of permitting only one train, on one track, at one time, between stations, eliminating chances of human error, and thus ensuring greater safety. It is to this, more than to any other single development, that increased safety of train movements can be attributed.

On single line, Neale's Ball Token instruments are in popular use. This instrument was invented by Mr Neale, an engineer of the ex-Great Indian Peninsula Railway and contains 'metal balls' called 'Tokens' normally looked inside the instrument. The working of this instrument is based on the principle that only one 'Token' can be taken out at one time by co-operative operation of a set of instruments connected electrically. This 'Token' is given to the driver as his authority to enter the block section. There can thus be one and only one train in a single line section at one time.

On a double line, the instruments used are usually interlocked with signals to prevent one train following another. There are several types in use. One such instrument in use on the Northern Railway is called the 'Carsen' instrument, and is the invention of Messrs Cargill and Sen Gupta, Signal Engineers of the ex-North Western Railway.

TELEPHONE AND TELECOMMUNICATION

Closely connected with signalling is the development of the telegraph and telephone. In the early years of the development of railways only telegraph instruments were provided for communication between stations. With the development of telecommunication, the train control system came into existence. Under this system all wayside stations are connected by telephones to the central control office. Train control telephones have been provided on all important sections and their provision has considerably improved the efficiency of train working. During the last war deputy control circuits were also installed on more important sections to provide the much needed, faster and more independent means of communication.

The railways have provided telephone exchanges in the offices of railway headquarters and districts. Teleprinters have also been installed on important long distance sections, superimposed on other circuits, where possible, to ensure uninterrupted, clear and rapid communication, effecting considerable savings.

Use has also been made of wireless communication, which not only links each railway headquarters with the district headquarters and important stations, but also the Railway Board's office with the headquarters of all railways in India. Telecommunication is regarded as the 'nerve centre' of efficient transportation system.

SIGNALLING MATERIAL

The Indian Railways have not been slow in evolving standard designs to make the procurement of materials easy, and to reduce the costs of manufacture. The Signalling and Interlocking Standards Committee, assisted by the Central Standards Office, has done work of great value. The Central Standards Office keeps in touch with developments of signalling in other advanced countries and thus full advantage is taken in evolving suitable designs for Indian Railways.

FUTURE OUTLOOK

With the recent amalgamation of the signalling and telecommunication branches directly under the General Manager in the newly integrated system of railways, a major step forward has been taken by the Ministry of Railways. With the facilities afforded by the Ministry of Railways for maintaining contact with signalling developments in other countries, it can also be said that the signalling standards and developments on the Indian Railways can keep abreast of improvements in other advanced countries.

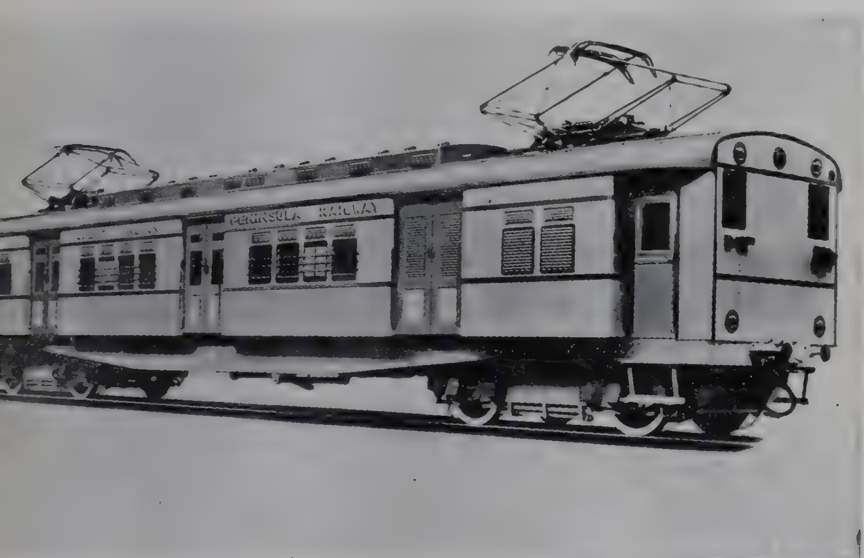
Above : One of the early Restaurant Car—1907.

Above : Interior of a Dining Car—1912.

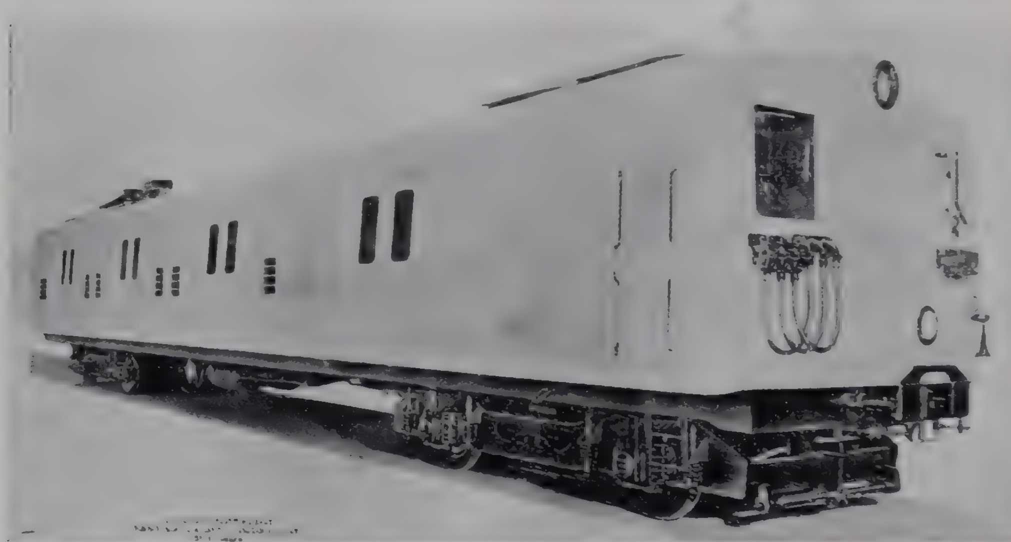
Below : A Third Class Coach on Calcutta-Madras Service—1913.

Above : A Metre Gauge Electric Train in use on Madras Suburban Service —1928.

Below : A Motor Coach for Bombay Suburban Service—1922.



Below : New Motor Coach for Bombay Suburban Service —1952.



Below : Interior of a new Third Class Coach for Bombay Suburban Service.

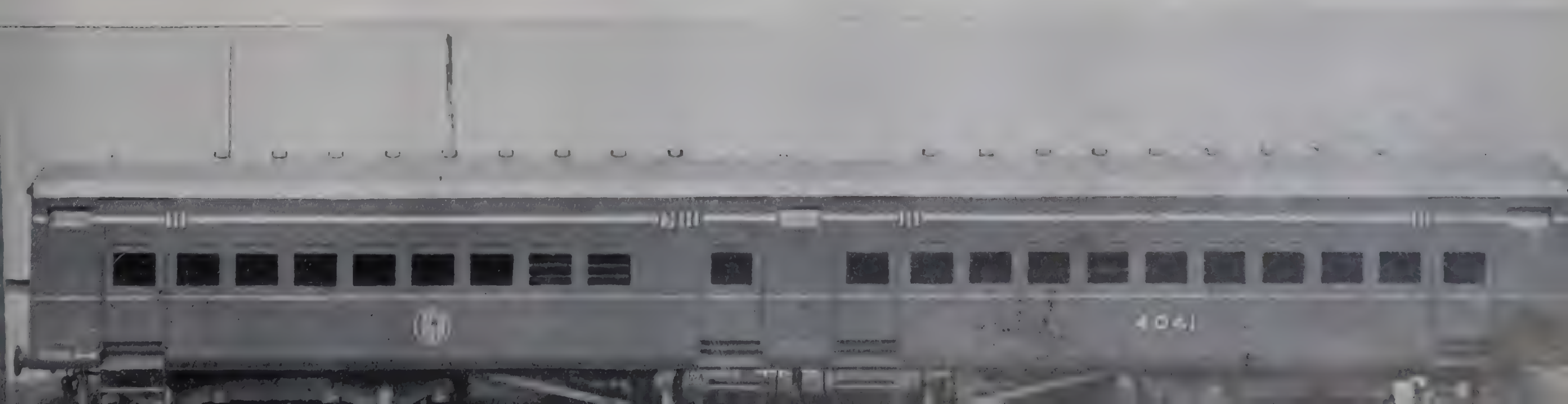
Below : Diesel Railcar in use on Nizam's State Railway—1940.

Above : Interior of the lavatory for Third Class in the new coaches.

Above right : Covered Wagon having Aluminium Body.

Right : New light weight all-metal Third Class Coach for Main Line Service—1952.

Below : A new all-metal Third Class Coach built by The Hindustan Aircraft Limited, Bangalore.



ought to pay first class fares from using them, all these things were not very comfortable, though they were better than being literally frozen to death on the outside of a coach.'

Writing in 1839 *The Railway Monitor* addressed the following advice to prospective third class travellers.

> 'The existing railway arrangement renders it imperative that you should provide yourself with a large stock of philosophy to enable you to put up with certain inconvenience, which you will be sure, to a greater or less extent to encounter on most lines. Make up your mind for unmitigated hail, rain, sleet, snow, thunder and lightning. Look out for a double allowance of smoke, dust, dirt and everything that is disagreeable. Be content to run a two-fold risk of life and limb. Do not expect the luxury of a seat. As an individual and as a traveller, you are one of the lower classes; a poor, beggarly, contemptible person, and your comforts and conveniences are not to be attended to.'

In 1844, in Great Britain, after considerable public agitation Gladstone's 'Cheap Trains Act' was passed. It provided for a penny-a-mile fare and made it imperative that 'railway coaches should be so constructed as to allow free admission of light and air, protection against wind, rain and cold, provision of lamps for night journeys and of seats with backs, of windows for 'look-outs,' and doors in sufficient number on each side to prevent confusion in getting in and out.'

THE THIRD CLASS

The earliest third class coaches introduced in India were designed on the same pattern as the contemporary third class carriages on British railways. They had truck bodies and outward opening doors. The seats had backs and were placed longitudinally. No provision existed for latrines. In only one respect early coaches were an improvement on some of the British railways. While on early British railways passengers had to bring their own candles, provision was made for oil lamps in Indian coaches. For several years goods wagons and even open trucks were used as substitutes for the transport of passengers, whenever standard stock was not available. The attitude of the railway authorities towards lower class passengers was based on the theory that what the average passenger required was 'just a means of being carried rapidly from one place to the other at minimum expense.' It was forty years later after considerable public agitation that the installation of latrines, a very elementary convenience, was taken in hand. It is not surprising, therefore, that the discomforts and inconveniences of third class passengers should have been the subject of strong, continuous and persistent public agitation during the entire course of hundred years of railway development.

DOUBLE-TIER COACHES

On the East Indian and the Great Indian Peninsula Railways third class carriages of double-tier construction were introduced in 1862. A model of one of these is still exhibited at the Public Relations Office of the Eastern Railway. In 1874, a rather retrograde step was taken ostensibly to provide for more accommodation at cheaper expense for lower class passengers. A fourth class coach was introduced in which the seating boards had been removed, and the passengers had to squat on the floor. There was already considerable overcrowding in third class carriages, but in these fourth class carriages passengers had to travel huddled together, sometimes in terrible heat. This led to a furore of public agitation till finally in 1885 benches were restored, but the system of having four classes continued. The original third class was named 'Intermediate' and the fourth class was continued to be called the third class.

The original third class coach was a four-wheeled unit constructed on wooden underframes. It had a normal carrying capacity for 70 passengers. The double-tier third class coaches had a carrying capacity of 120 passengers of which 70 were carried in the lower tier and 50 in the upper. The wheel base of these carriages was twelve feet, and axle load as low as eight tons. Axle boxes were of cast iron, with a loose brass insert for the bearing. Laminated springs were used to absorb road shocks. The buffers were of wrought iron bolted to the wooden headstocks. Double-tier coaches were gradually discarded and the seating capacity of ordinary coaches was considerably increased. The standard coaches were in due course enlarged to accommodate 93 passengers. They continued to have timber bodies on timber underframes, reinforced with steel knees and gussets.

Coach builders in Europe had in the meantime developed an all-steel underframe on which was mounted a wooden coach body. Experience in India indicated that timber underframes were susceptible to deterioration in service and necessitated expensive repairs. The all-steel underframe as developed in Europe with wooden coach bodies was introduced in India in 1885. At the same time considerable improvements were made in the design of the body. The construction in wood of passenger bodies, however, continued to be the common feature not only of third class carriages, but also of upper class carriages till less than a decade ago, changes, if any were made in seating arrangements, ventilation and in various mechanical improvements intended for safer, more comfortable and smoother travel.

Latrines in third class carriages were first introduced in 1891 and gradually became part of the construction of all third class coaches.

In 1922, 'all steel multiple coaches' were imported from England for the electric suburban trains in Bombay area. In 1927, 250 all-steel coaches were imported for service on the East Indian and North Western Railways. About

1940, a small number of all-steel broad-gauge coaches were built in some railway workshops in India. It was not, however, till 1949 that the Railway Board adopted as a future standard the all-steel designs which offer a far greater measure of safety to the travelling public compared with the timber body coaches. Soon after, an order for 100 coaches was placed with the Hindustan Aircraft Limited, Bangalore, and this factory has since been regularly producing all-steel broad-gauge coaches for Indian Railways.

Simultaneously with the decision to build all-steel coaches bodies, the Railway Board also accepted what has now come to be known as the 'integral design' in which the underframe and the body are one unit. The new coaches are longer and wider, affording greater space to passengers. Hitherto the statutory limit for broad gauge body coaches was 68 feet by 10 feet. These dimensions were increased to 70 feet and 11 feet 8 inches respectively. Several coaches of the new design were constructed in India and were exhibited as part of the exhibition train named 'The Silver Arrow' in 1947.

It was, however, soon realised that the width of 11 feet 8 inches was unsuitable for the existing track, and its adoption as standard would result in much avoidable expenditure. The design was, therefore, appropriately altered.

LATEST IN COACHES

Swiss built coaches constructed at Schlieren, Zurich, and imported recently to serve as a standard design for carriages, represent a revolutionary advance in comfort, safety and smoothness in travel. These are of all welded steel fabrication, of a light weight design, employing a floating bolster support of longitudinally placed laminated springs linked to the bogie-frame. The bearing springs are of helical type working in combination with hydraulic dash pots and rubber pads arranged on roller bearing axleboxes. The strength inherent in the integrally constructed coaches renders them practically immune to the hazard of telescoping and wrecking of bodies, in the event of any serious accident. The springing arrangement ensures smooth riding of the carriage during varying speeds making travelling very much more comfortable.

UPPER CLASS PASSENGERS

Upper class passengers were given greater consideration from earliest times. In England, in early days, those who could afford to reserve a whole truck placed their own horse carriage on the truck and made the journey sitting in the carriage. Whether it was for this reason or because the earlier railways were looked upon as a substitute for the stage coach, the first design of upper class coaches were both colourful and intended to look as much like stage coaches and horse carriages as possible. The guard rode outside as on a coach. Luggage was also usually carried outside. One of the first railway carriages, the 'Experiment,' had the

'boot' for the guard at both ends, so that the carriage need not be turned round. Even the width of the carriage was originally taken from the width of an old coach, and the lights outside the royal saloon, built as late as 1848 for Queen Victoria by the Kent and East Sussex Railway, were those of the road coaches. First class carriages had roofs and were provided with glass pane windows. Second class carriages were covered, but had neither doors nor windows. They had two open entrances leading into transversally placed seats on which passengers sat facing each other. Incidentally, this arrangement of seats originally gave birth to the idea of separating railway coaches into compartments.

The arrangement of having bogies divided into small or big compartments of various classes became the vogue in England and in many other countries of the continent. In the United States, Canada and in later years, in Russia, railway carriages with corridors joined to each other by vestibules became popular. Early first and second class carriages were painted and provided with padded cushion seats on the style of a horse-carriage. Seats in the first class were better padded, cushioned and upholstered than those of the second class. A writer describing the difference between first and second class travel in England during the early days observed:

> 'The chief inconvenience peculiar to this class (first class) is that your fare will be twice as much as you ought in fairness to pay. You run perhaps rather less risk in this class than in the other, of having your neck broken ; but you must not be unprepared for such a contingency.
>
> 'In travelling by the second class, you will do well to wear a respirator, unless you wish to be choked with dust and ashes from the engine close in front of you. Also, if you are going far, you are recommended to put on a diving dress like the one used at polytechnic ; because if it should rain much during your journey, the sides of the carriage being open, you will have to ride in a pool of water. Your dignity must not be hurt, should you have for next neighbour a ragamuffin in handcuffs with a policeman next to him ; the harnessed hard seat is a mere trifle ; that is the least of the annoyances to which you are judiciously subjected, with the view of driving you into the first class train.'

UPPER CLASS TRAVEL IN INDIA

In India the basic construction of upper class coaches has followed closely the third class pattern. In fact, the same bogie is in many cases divided into compartments of various classes. The two-tier experiment was tried in the case of upper class passengers, provision being made in the upper tier for the passengers and in lower deck for the servants who travelled with them. In 1863 the first luxury saloon, a four-wheeler carriage was built for His Excellency the Governor of Bombay in the Bombay, Baroda and Central India workshops at Amroli. The coach height was elevated and within the somewhat cramped confines of a four-wheeler coach, a sitting-cum-bed room was arranged in

one half of the coach, while the opposite half served as the dining room. The lower floor deck of the coach provided accommodation for servants. The inter class has never been much better than the third, except that in earlier years wooden benches were padded and were covered with canvas or hessian. The second class is a distinct improvement on the intermediate, in the sense that it has all along been a near approach to the first class in respect of lighting, number of windows and shutters, sanitary provisions, seating, cushions, etc.

The comforts of upper class travel in India during the past hundred years are fairly comparable with those available in the advanced countries of the world. An Indian first class on some of the main railways, in fact, provides more amenities and comforts, at comparable rates, than anywhere else. Louis Rousselet in his book 'India and its Native Princes,' gives an interesting and vivid description of the conditions of upper class railway travel in India during the sixties of the last century. He made a journey from Agra to Calcutta and back which was accomplished in five days and a half. 'Thanks to the sleeping carriages,' he writes,

> 'I had been able to travel over this immense distance with comparatively little fatigue—sleeping at night on a comfortable little bed, and walking up and down in my carriage during the day ; and, at stations provided with buffets, I found a servant who, when he had taken the orders for my meal, telegraphed it to the next station, where my breakfast or dinner awaited my arrival.'

It would seem, that provision for upper class sleepers had been made on Indian trains several years earlier than the vogue of the Pullman was introduced in the United States. Describing the type of first class carriages which then existed, he writes,

> 'As the train left at two in the morning, we were placed in one of the comfortable sleeping carriages which the East India Railway had recently introduced on its lines. These carriages contained only two compartments, in each of which there is but a single seat, the movable back of which takes off and, being fastened by straps, forms a sort of couch of the same description as the beds used in ships cabins. On the opposite side of the carriage are two closets—one or the toilet, the other for conveniences. By paying a slight addition in the price of the ordinary fares, you might thus travel surrounded by all the comforts so essential in this country.'

Early first class compartments generally had one to two bunks: The upper bunk when provided was collapsible and could be hooked back when not in use. Pictures of these compartments are still available and one of them shows two travellers reclining in comfort in the two bunks, one of them smoking an Indian hubble bubble while the two servants are busy polishing up their jack boots. Special provision has continued to be made on all railways for servant compartments side by side with upper class compartments to enable attendants

travelling with upper class passengers to be available throughout the journey. Upper class compartments of two or more bunks have a toilet, separately attached to each, fully equipped with modern conveniences. First class toilets have provision for bath tubs, which in recent years have been replaced by shower baths. Some of the coaches of recent design have corridors.

The 'Pullman' so familiar to long distance travellers in many parts of the world, has never existed in India. Normally, with appropriate reservations, an upper class passenger gets a full berth to himself while travelling at night, with the added advantage of a modern well-equipped toilet attached. The only class comparable to the luxury, comfort and convenience of travel of a first class single seater or coupe in India, is perhaps a single or a double-bed sleeperette, on some of the American trains, with this difference that on the Indian railways this provides the normal mode of travel for upper class passengers, while on the American railways such comfort and luxury involve enormous extra expense.

AIR-CONDITIONED COACHES

Air-conditioned coaches were first introduced in India in 1936. It goes to the credit of engineers on Indian Railways that the first five air-conditioned coaches employing the electro-mechanical air-conditioning system were constructed in the Indian Railway Workshops at Matunga, near Bombay. During the war, additions could not be made to the existing stock. Since 1950 several new air-conditioned coaches have been built in Indian Railway Workshops, which are in many ways a considerable improvement on the earlier coaches.

Just as the tin-foot warmer on American and Continental railways was the precursor of modern mechanically-heated carriages, a crude but effective system of keeping temperatures down in railway carriages during the hot weather existed as early as the eighteen sixties on the Indian Railways. Describing this arrangement, M. Louis Rousselet writes, 'Travellers proceeding from Bombay to Calcutta by the express trains now are accommodated with carriages with *Khas Khas* in mattings which are kept moist by reservoirs specially provided for the purpose. This moisture, enveloping the carriage, preserves the temperature at a degree of coolness sufficient almost to extinguish the risk of incurring sun stroke or apoplexy, at one time so frequent on these journeys.'

A modern air-conditioned coach on any of the Indian Railways is dust proof, has an attached toilet and bathroom and is richly and elegantly furnished. It is the last word in smooth and comfortable travel. Large sized windows afford the traveller an excellent view of the scenery in a country in which the landscape presents picturesque variations. The outer-glass which is fixed to prevent ingress of dust is also tinted so as to eliminate glare. The bunks are of ample size equipped with devices whereby they can be converted into comfortable seats during the day and cosy beds by night. The general decore is elegant and artistic. Lights are

conveniently arranged and ample provision has been made for cupboards and hangers, a source of great convenience during long distance travel.

ELECTRIC TRAIN COACHES

Carriages on the suburban electric trains have had the advantage of more advanced designs since suburban electric trains started running only in 1926. From their very inception these lines introduced all-steel electric multiple unit bogie coaches with seats conveniently arranged to permit easy entry and exit to passengers and a lot of leg room. The carriages which have been placed in service in 1952 are as modern in construction and design as are to be seen anywhere in the world. The new stock is of all-metal light weight construction with comfortably arranged seats. Ample provision has been made for revolving fans and the compartments are lit with fluorescent lights.

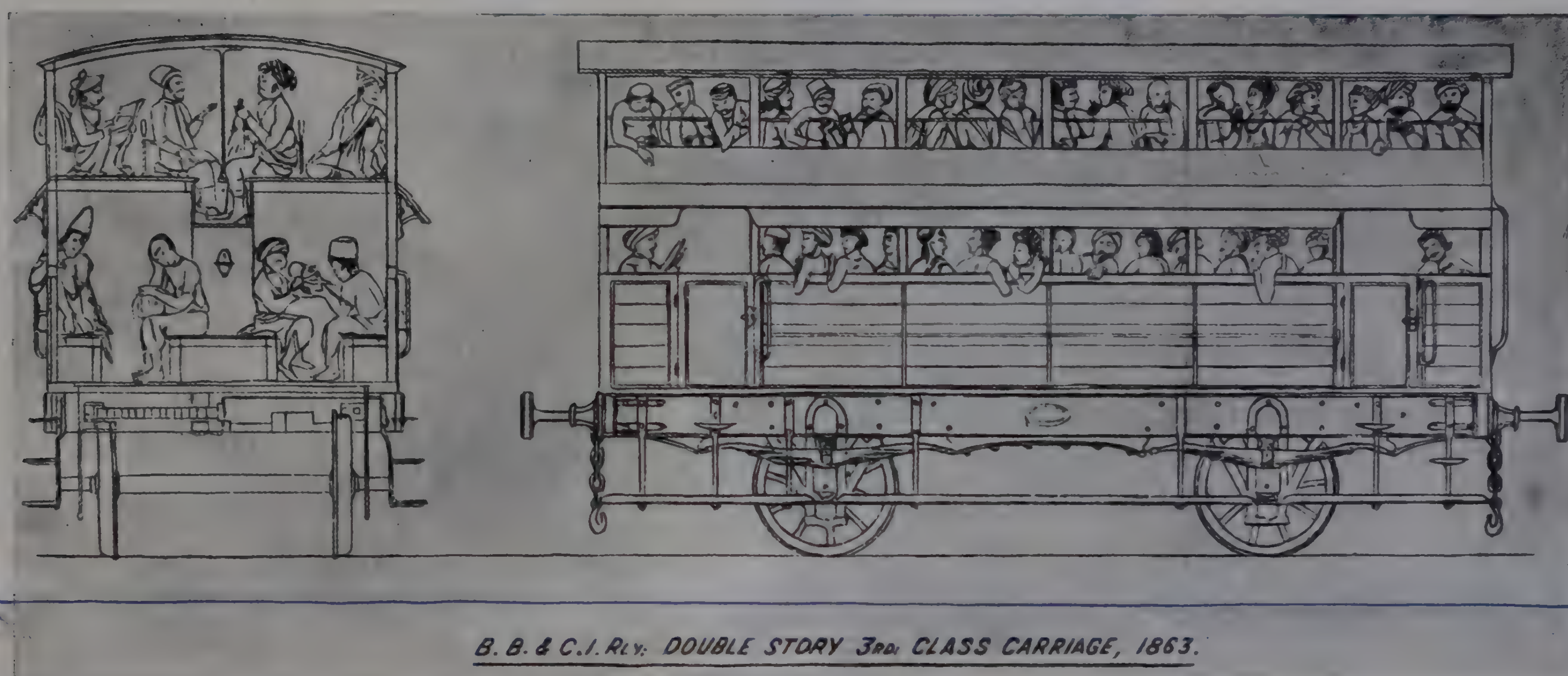
CHRONOLOGY OF CHANGES

Before concluding this interesting survey of the various stages in the development of modern coaches on Indian Railways, it is desirable to refer chronologically to some of the major constructional changes which have taken place during the past hundred years. Early carriages opened on the outside. Inward opening doors were first introduced in 1909. Four-wheeler coaches were replaced by bogie coaches of 56 feet 10 inches by 9 feet dimensions in 1903. During this year the first bogie dining saloon was placed on the lines. The latest bogie coaches are 70 feet by 10 feet 8 inches. The vacuum brake was first introduced in 1879 while roller bearing axleboxes were first applied in 1930.

In earlier trains, lights were provided by candles brought by the passengers themselves and placed behind their seats. Later in some carriages oil and parafin lamps were introduced. It was in the eighteen sixties that gas lamps were employed on some of the British and Continental railways. In India, oil lamps were provided in the carriages from the very beginning. By the eighteen-seventies gas lamps were fairly common. To the Jodhpur Railway, run by an Indian State, belongs the distinction of introducing the first electric lights in carriages in 1902. By 1907 lighting carriages by electricity became fairly popular on all the main lines.

Above : A typical coach in use a hundred years ago.

← 17 5 cm → 100 zine.



Above : A double-decker Third Class carriage used by Bombay, Baroda and Central India Railway.

Right : A double-decker carriage built in Howrah for East Indian Railway—1864.

Above : A Covered Carriage Truck to carry 6-ton load—1888.

Above : A Metre Gauge Saloon built in Agra Shops of Bombay, Baroda and Central India Railway specially for the tour of Prince of Wales (later King Edward VII)

Right : One of the early combined Third Class and Brake and Luggage Van. The Third Class Compartment was meant for use by Europeans and Eurasians only, a policy of discrimination followed at that time.

Below : An Upper Class Composite Coach built at Perambur Works—1899.

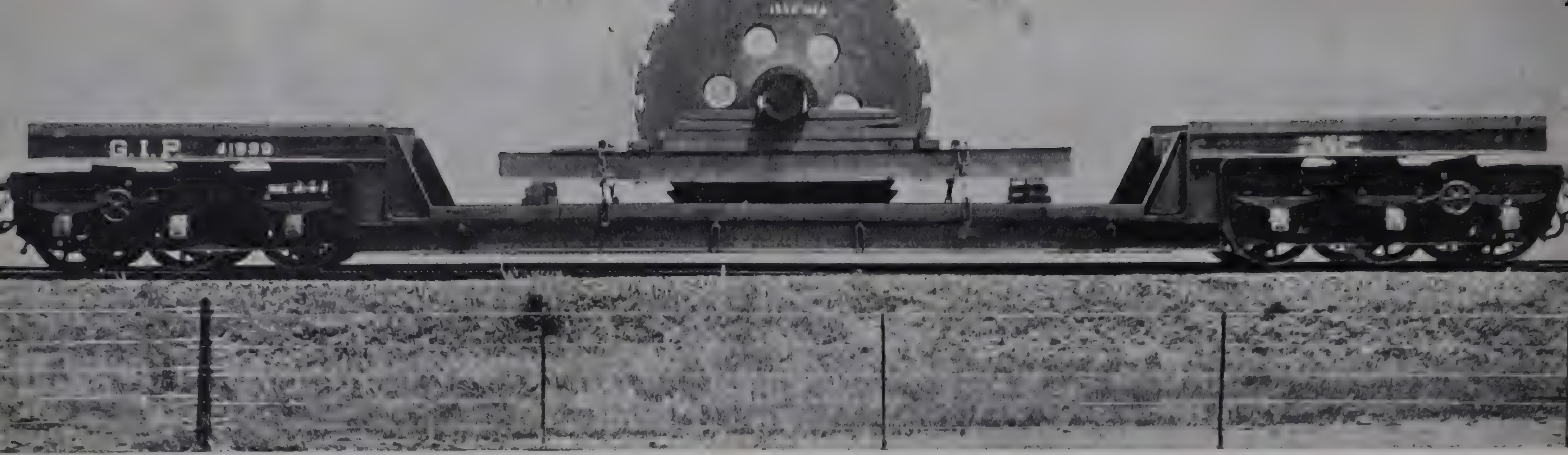
Right : Steam Motor Coach in use on the Bhopal-Sehor Service—1906.

Above : A Cattle Wagon for transport of live-stock.

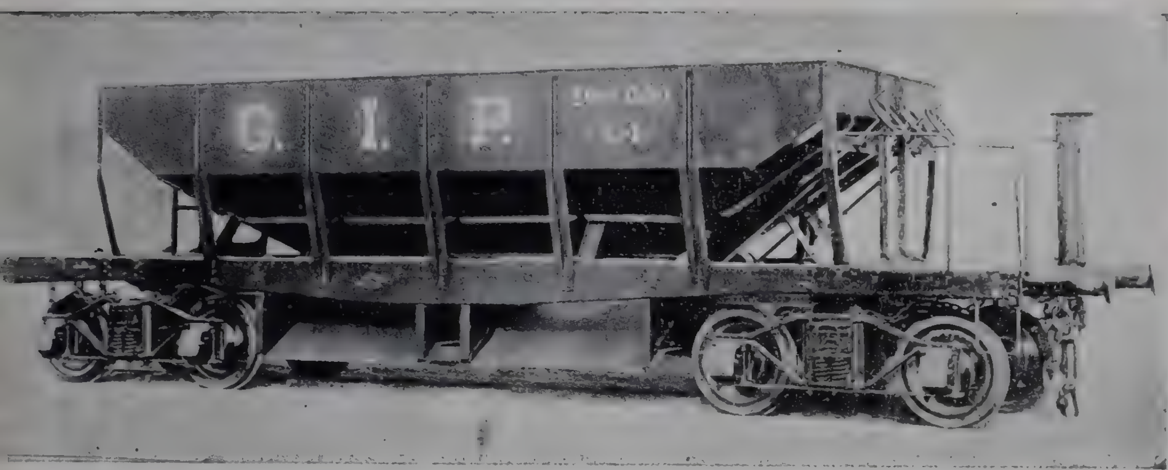
Above : Metre gauge locomotive being transported in a broad gauge well wagon.

Above : Bogie Rail Wagon in use on Narrow (2′-6″) Gauge.

Below : A Bogie Covered Wagon built in 1911.

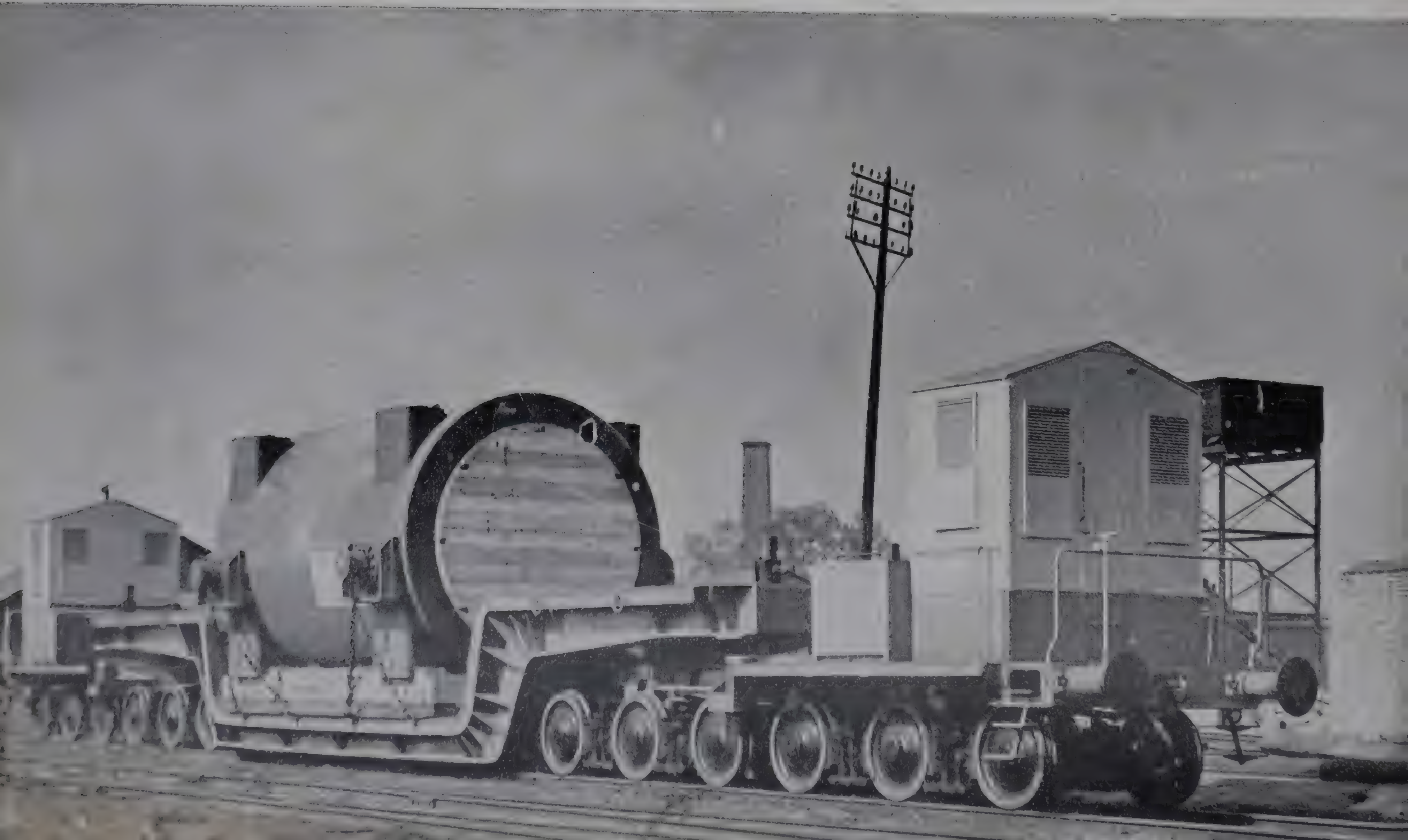


Above : A Bogie well Truck built in 1913 to carry consignments of big dimensions and of weight up to 40 tons.



Left : A Bogie Hopper Wagon built in 1915.

Below : A most modern Well Truck designed to carry consignments weighing up to 130 tons. This wagon has been built to meet the demands of various River Valley Projects in the country and is probably the only one of its kind in Asia.



XII. Wagons

When early proposals for introducing railways were being discussed in India there were many highly placed in the administration who felt that it would be impossible to persuade the people to make use of railways, and that railways would have to depend primarily, if not solely, on income from goods traffic. Although these sceptical forebodings were soon belied, goods traffic has continued to be the major source of income of Indian Railways, and has been a valuable source for developing the economic life of the country.

Interest in goods traffic in every country has progressively increased, and railways have employed better and newer methods to ensure the safe and more rapid haulage of bigger and heavier loads of various types of merchandise.

In Russia, the emphasis all along has been more on goods rather than passengers. During the Soviet regime particularly, very much greater interest has been taken in increasing the goods carrying capacity of railways rather than offering amenities to passengers. On American railways where double tracks are few all sorts of mechanical contrivances are employed to enable ever increasing goods loads to be carried by trains.

EARLY WAGONS

Just as the common four-wheel box type truck was the first to be employed for carrying passengers, it was also the first to be employed for carrying goods. In exterior design and shape the passenger carriage adopted the pattern of the horse-drawn coach, while the goods wagon retained its similarity with the early horse-drawn wagon employed in England for hauling coal or timber.

With the passage of time, and to meet the needs of a variety of merchandise, the size, shape and design of the truck has undergone several changes. In India, England, and some of the countries of the Continent the four-wheel type still continues to be in popular use. The earliest goods wagons had a wooden underframe support, and a four sided wooden body reinforced with metal strappings and knees. The wagons were mounted on wheels with wrought iron tyres and spokes. The maximum load carried by earliest wagons was 12 tons. These were either covered or open.

In the early part of the present century, steel wagons were introduced on some of the railways in England and on the Continent. Both in respect of robustness of construction and increased capacity, they were superior to timber wagons. A new type of wagon employing structural rolled steel section and plates came to be adopted as standard from 1908 onwards in India. India was one of the first countries to appreciate the advantages of standardisation and introduced standard designs for all-steel wagons of various types over its entire railway system. Standardisation has made possible, economy in stocking of spares and maintenance. Some of these wagons were designed with flap doors and some with dropping ends. Covered wagons were evolved with vertical hinge doors, in some cases with dropping flap sections to meet the need for the transport of cattle.

DIFFERENT TYPES

While these were basic designs, several alterations were required to enable the transport of commodities ranging from coal to sand, from heavy timber logs to sugar-cane, from mineral ore to rubble, and as various as elephants, tigers, rabbits, cattle, poultry, petrol, water, oils, chemicals, cloth, and foodgrains. This naturally led to the development of different types such as wagons for coal, coke or timber, oil, petrol, and water tanks, travelling cranes and gas holders, ballast wagons, wagons for explosives and ammunition, and wagons for conveying automobiles, and for transporting general merchandise. While the four-wheeler continued to be the more popular basic type, the bogie type was introduced in later years to meet special requirements, and also to enable bigger freight loads to be hauled.

To give an idea of the manner in which the basic four-wheeler and the bogie were adapted to meet the requirements of different kinds of freight, some of the types of wagons in use deserve description. Cattle wagons are divided into pens and are provided with ventilators so as to induce a lively circulation of air to afford comfort to the cattle. Special provision is made for drainage of waste matter. Troughs are provided for feeding and drinking. The timber truck is an open truck with a skeleton body, designed to carry various sizes of timber. The design of the body is such as to prevent dislodgement of timber boards in transit. The Hopper type of wagon is for carrying ballast, minerals and coal. Powder vans have a heavy timber lining with a thick insulation to check transmission of heat to the powder. The metallic fittings such as hinges, clips and brackets used inside the vans are made of gun metal to avoid the risk of sparking by metallic contact with explosives.

Bogie refrigerated vans have a double-case timber body insulated with slab cork. Cam-operated spring sealed doors are provided to ensure an airtight closure. The flooring is of a special cement compound covering a timber boarded under-surface insulated with cork. In the middle of the van an ice bunk is

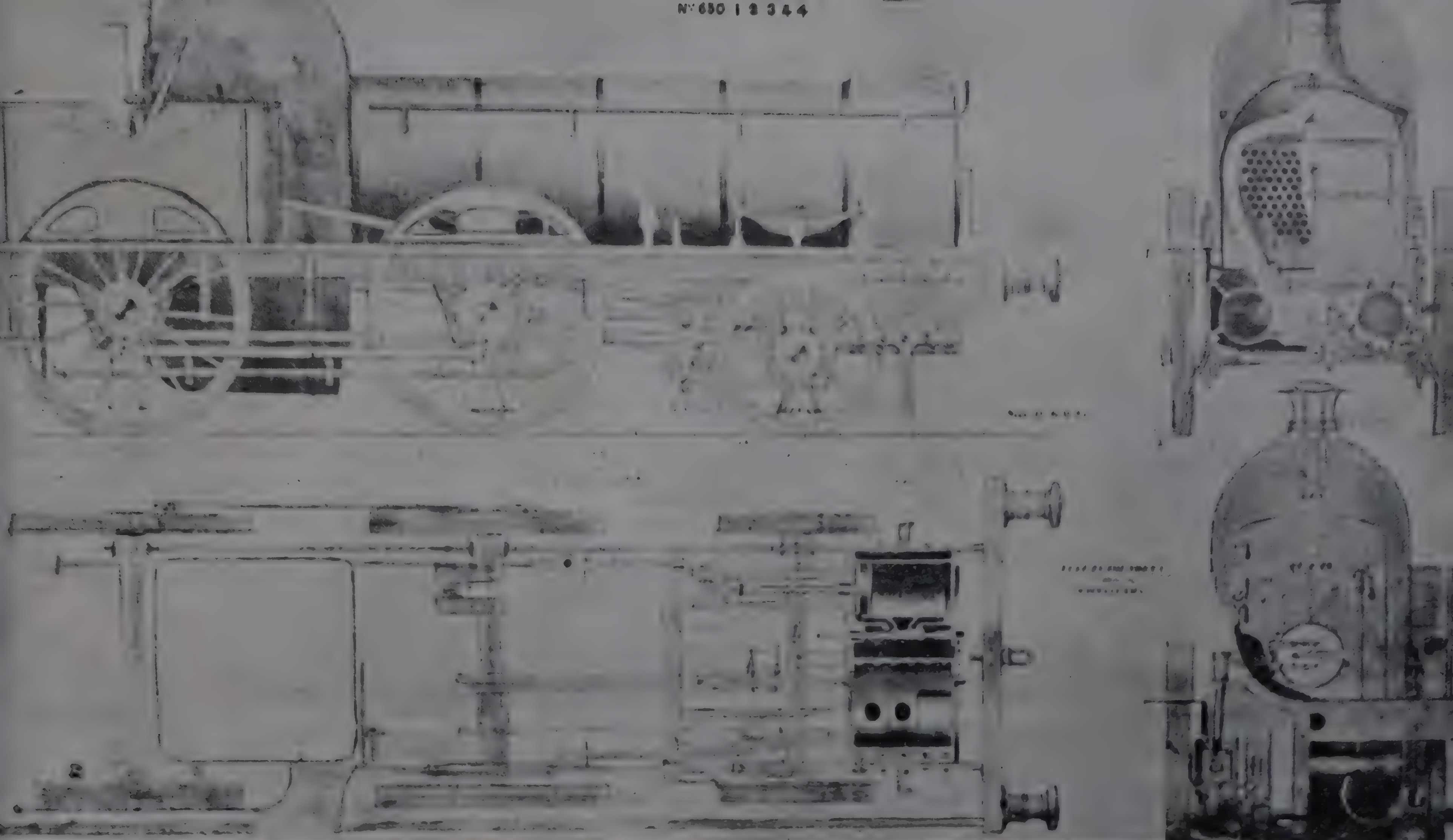
provided for carrying blocks of ice on steel racks. Blower fans placed at ceiling level are arranged to blow air, over the ice blocks, through a duct extending along the length of the van. A cheaper adaptation of these bogies has recently been introduced on the Western Railway for transporting chilled milk packed in eight gallon cans from Gujerat district to meet the milk requirements of Bombay city.

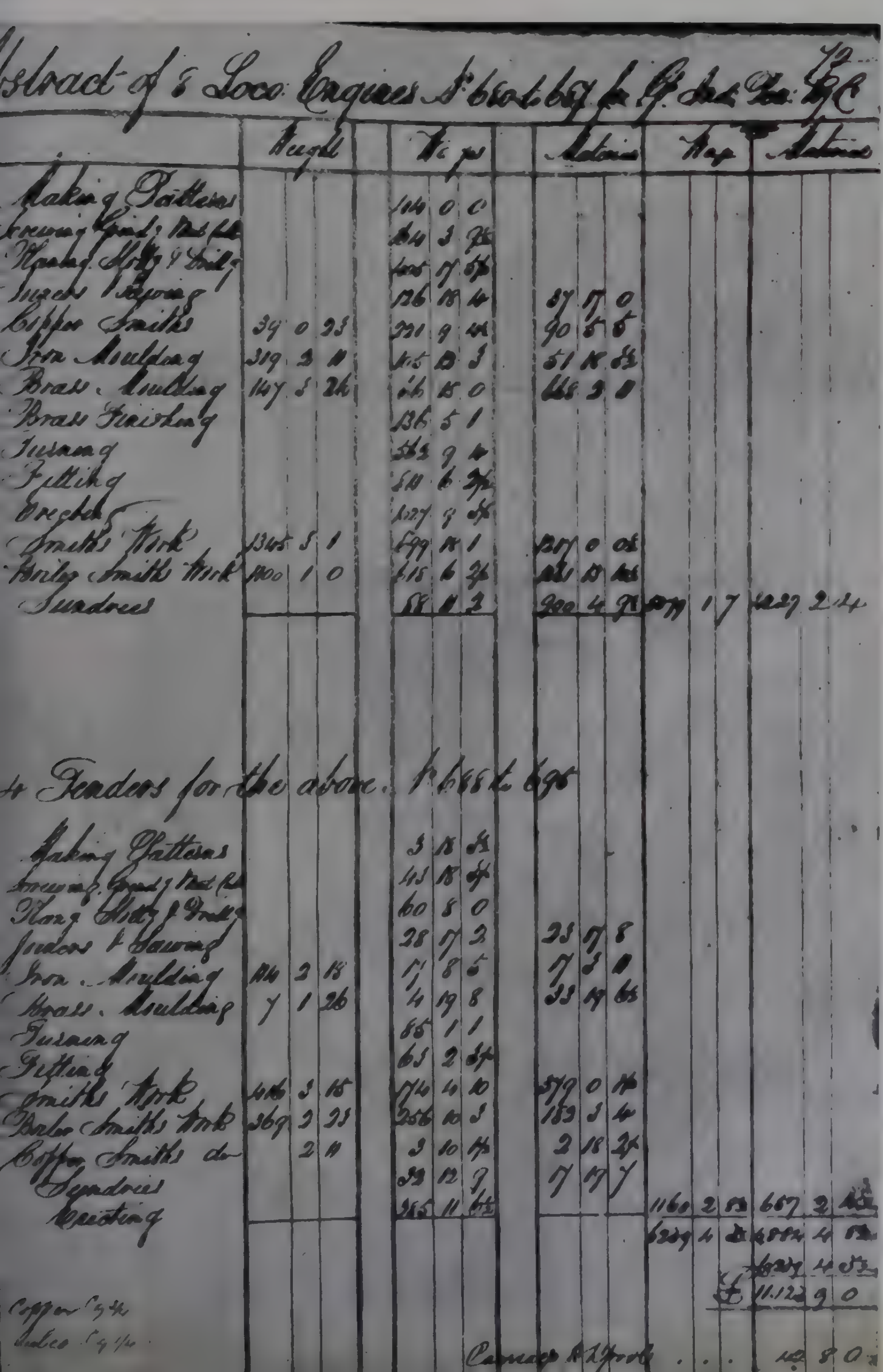
Oil tank wagons have a cylindrical steel tank designed to carry oils of many varieties. Petrol tank wagons are equipped with pressure release safety valves, vapour return valves, and a sealing flap in the manhole to prevent the loss of petrol vapour. The wagons are finished with aluminium or white paint to minimise inhibition of solar heat.

THE WELL-WAGON

The well-wagon is designed for the transport of bulky articles which might otherwise infringe the maximum moving dimensions due to excessive height. The giant type recently constructed can carry a load of 130 tons distributed over a 'short well'. As a type in wagon construction it is outstanding, if not in the world, at least in Europe and Asia. These wagons were built by a Swiss firm, but the design, particulars and specifications were prepared by the Central Standards Office of the Ministry of Railways in India. The main girder of the well is supported through specially designed pivots which are cushioned with rubber springs to take initial shocks at two sub-structures at either end, and these in turn are supported by two six-wheel bogies fitted with roller bearings. On the pivots manually operated hydraulic jacks have been incorporated and these can raise or lower the main girder to the desired height when passing through fixed structures with out-of-gauge loads. To maintain a satisfactory brake-load ratio, the brake gear has been fitted with three different settings to provide for different brake powers to suit the various ranges of loads that are likely to be carried. One brake cab has been provided on each sub-structure for a specially trained crew. An important feature of the design is that the wagon can easily take a right-angle turn with a turn-table of only 27 feet diameter, enabling it to discharge heavy loads of important equipment and machinery at the site of some of the multipurpose irrigational and hydro-electric projects which have recently been taken in hand in various parts of the country. The all-welded construction has been used in order to reduce the tare weight to a minimum. The giant wagon is 90 feet 5 inches in length over the buffers and 56 feet 7 inches between the main pivots. This type of well-wagon, which owes its design to the enterprise and resourcefulness of engineers of Indian Railways, is proving to be of immense help in the transport of heavy mechanical equipment, for the rapid completion of such great national enterprises as the Damodar Valley project, the Bhakra Nangal project and the Hirakud Dam.

A distinct improvement in terms of reduced tare weight has been made possible in the recent experimental designs of four-wheeled covered and open wagons with aluminium bodies. These were put in service on the Western, Eastern, Southern and Central Railways in 1951.





[illegible]stract of 8 Loco: Engines No. 660 to 667 for Gt. Ind. Pen. Ry. C

	Weight			Wages			Materials			Wages			Materials		
Making Patterns				104	0	0									
[illegible]				[illegible]	3	[illegible]									
[illegible]				[illegible]	17	[illegible]									
[illegible]				126	18	4	87	17	0						
Copper Smiths	39	0	23	221	9	4	90	5	6						
Iron Moulding	319	2	11	[illegible]	13	3	51	18	[illegible]						
Brass Moulding	147	3	26	[illegible]	15	0	[illegible]	2	0						
Brass Finishing				136	5	1									
Turning				[illegible]	9	4									
Fitting				511	6	[illegible]									
Erecting				127	9	[illegible]									
Smiths Work	1365	5	1	699	18	1	[illegible]	0	[illegible]						
Boiler Smiths Work	1400	1	0	615	6	[illegible]	[illegible]	13	[illegible]						
Sundries				58	[illegible]	3	900	4	[illegible]	[illegible]	1	7	[illegible]	2	[illegible]

4 Tenders for the above No. 688 to 695

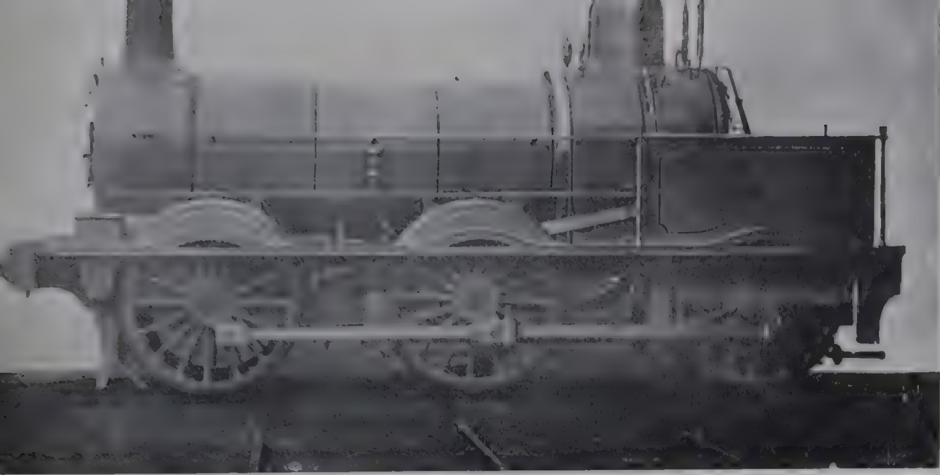
	Weight			Wages			Materials			Wages			Materials		
Making Patterns				3	18	[illegible]									
[illegible]				45	18	[illegible]									
[illegible]				60	8	0									
[illegible]				28	17	2	23	17	8						
Iron Moulding	114	2	18	17	8	5	17	3	0						
Brass Moulding	7	1	26	4	19	8	33	19	[illegible]						
Turning				85	1	1									
Fitting				65	2	[illegible]									
Smiths Work	[illegible]	3	15	774	4	10	579	0	[illegible]						
Boiler Smiths Work	369	2	23	256	10	3	183	3	4						
Copper Smiths do		2	11	3	10	[illegible]	2	18	[illegible]						
Sundries				32	12	7	7	17	7						
Erecting				185	11	[illegible]				1160	2	[illegible]	657	2	[illegible]
										6239	4	[illegible]	[illegible]	4	[illegible]
													[illegible]	4	[illegible]
												£	11.122	9	0

Copper [illegible]
[illegible]

Carriage to L'pool . . . 10 8 0

Above : The first locomotive for India manufactured and supplied by the Valcan Foundry limited.

Left : Page of original ledger showing abstract of the costs of the first locomotives for India.



Above : The Madras Railways were the first to employ the 0-6-0 class of goods locomotive in the counry. The unit illustrated is nearly 90 years old.

Above : The O. & R. followed the example of the Madras Railwa in adopting the 0-6-0 wheeler engine for its earliest locomotiv The unit shown has 40″×20″ cylinder and 48″ wheels and wa builtin 1869.

Above : The 4-4-0 class of locomotive came into fairly general use for passenger services in India about 1875. Some of these have been re-boilered and re-fitted and are still to be seen in operation on Indian Railways on light sections.

Below : The Eastern Bengal Railway in 1878 introduced the 2-4-0 locomotive with tender as illustrated. The unit has 12″×22″ cylinder with 66″ diameter wheels.

XIII. Locomotives

AMONG MECHANICAL CONTRIVANCES introduced during the modern scientific age, perhaps nothing has so caught the imagination of the common people, especially the younger folk, all over the world as the steam locomotive, sometimes referred to as the 'Iron Horse.' Even though more recent years have seen the development of the automobile and the aeroplane, the steam locomotive continues to exercise its spell over younger minds. There is still a fascination in the spectacle of a large steam engine pulling a heavy train, ejecting its steam and smoke high into the air with a rhythmic exhaust beat awakening the echoes.

During the early nineteenth century, several inventions were tried in England such as the George Stephenson's locomotive, Brandreth's patented Cyclopede, William Mann's locomotive, AdCock's steam coach, Gibb's steam drag, Gurney's steam coach etc, but the honour of being adopted as the approved 'Iron Horse' of the scientific age went to George Stephenson's 'Rocket.' The 'Rocket' gaily painted in yellow, black and white, is vividly described by Miss Fanny Kemble who made a journey on it in 1830 along with George Stephenson himself.

> 'We were introduced,' she writes, 'to the little engine which was to drag us along the rails. She (for they make these curious little fire horses all mares) consisted of a boiler, a stove, a platform, a bench, and behind the bench a barrel containing enough water to prevent her being thirsty for 15 miles,—the whole machine not bigger than a common fire engine. She goes upon two wheels which are her feet, and are moved by bright steel legs called pistons; these are propelled by steam, and in proportion as more steam is applied to the upper extremities (the hip joints, I suppose) of these pistons, the faster they move the wheels and when it is desirable to diminish the speed, the steam, which unless suffered to escape would burst the boiler, evaporates through a safety valve into the air. The reins, bit and bridle of this wonderful beast, is a small steel handle which applies or withdraws the steam from its legs or pistons, so that a child might manage it. The coals, which are its oats, were under the bench and there was a small glass tube affixed to the boiler with water in it, which indicates by its fullness or emptiness when the creature wants water which is immediately conveyed to it from its reservoirs. There is a chimney to the stove. But as they burn coke there is none of

> the dreadful black smoke which accompanies the progress of a steam vessel. This snorting little animal, which I feel rather inclined to pat, was then harnessed to our carriage, and Mr. Stephenson having taken me on the bench of the engine with him, we started at about ten miles an hour.'

From the light locomotives of Stephenson's days, there have been great developments up to modern times. Compared to the 'Rocket,' which was no heavier than a modern fire engine, some modern steam locomotives have an overall weight exceeding 850,000 lb. There has been a large increase in the number of axles. Instead of the two axles of the 'Rocket,' modern units may have 14 or more axles, and speeds which in Stephenson's time were severely restricted, are today in regular service, in certain countries exceeding a hundred miles per hour. Yet, the basic principles on which George Stephenson's 'Rocket' was constructed still remain common to the large multitude of different classes of steam locomotives that have since been built. Stated in the simple language of Miss Fanny Kemble, the 'Iron Horse' still moves on steam, requires heat and water, and the necessary appliances which can divert the resulting steam into channels intended to set the machine into motion.

A COMPLICATED MACHINE

It all sounds very simple. And yet every phase of locomotive development has behind it years of research and hard labour, and the pooled intelligence of railway engineers from all parts of the world. Speaking at the Institute of Locomotive Engineers in England in 1944, the President, Mr S. Graff-Baker said:

> 'The steam locomotive, as we know it, is a machine with certain physical limitations and certain detrimental features. It is limited in power by the loading gauge and in efficiency by the relatively limited temperature range. It has detrimental effects on the track and structures due to the extreme difficulty—in spite of improvements—of obtaining a mechanical balance at varying speeds, and in this connection it is only proper to observe that the track and structure are as essential a part of the railway as the locomotive. With these difficulties the fact remains that the steam locomotive is a magnificent machine, and has done more for the cause of civilisation than any other effort of mechanical engineering.........'

Within two years of the appearance of the 'Rocket' in regular service in Britain, pioneer steam locomotives, the 'Best Friend of Charlestons' and the 'Old Iron Sides,' were pulling service trains in the new countries across the Atlantic. For several years most of the locomotives produced were the work of builders in the United Kingdom or in the United States. Before 1853, however, when the first trains began to operate in India, locomotive builders in other countries particularly Germany were also entering the field. Partly because of

India's political relationship with England, and partly because the railway companies in India were British-owned, and their engineers had received training on British railways, almost all the locomotives imported into India till ten years ago have been of British manufacture.

" LORD FALKLAND "

The locomotive, 'Lord Falkland,' which was employed on the historic first train which in 1853 left Bombay for Thana, was what in technical language is called a '2-4-0' tender engine. It was built by the Vulcan Foundry in England. A steam locomotive, it may be pointed out, is conventionally composed of two vehicles, namely, the engine proper or the prime mover, and the tender for carrying fuel and water. In some cases, builders combined the two units into a tank locomotive, that is, as a single vehicle which is the prime mover with tanks and bunkers supported by its own frame. More recently, larger type locomotives with articulated frames such as the 'Mallet' and 'Garratt' types have also made their appearance. Locomotives are generally classed into types according to their wheel arrangement. A '2-4-0' engine would consist of one axle (two wheels) guiding in front, followed by two axles (four wheels) coupled together and driven by the main cylinders through the connecting rods. Such a unit would have no trailing carrying axle. A '2-4-2' unit would be similar to the above but would also have a trailing axle. A '2-2-2' tank engine would indicate a unit with a leading carrying axle, a central driving axle and a trailing carrying axle. It is usual that the carrying wheel diameters are substantially smaller than the coupled or driving wheel diameters. Much more complicated arrangements are employed in modern locomotives. Thus a modern Mallet articulated locomotive may have a wheel arrangement classified as follows: '2-8-0+2-8-4' and bogie tender. A 'Grant' type locomotive, which does not employ a separate tender, might be classified as a '4-8-2+2-8-4'.

"THE EXPRESS"

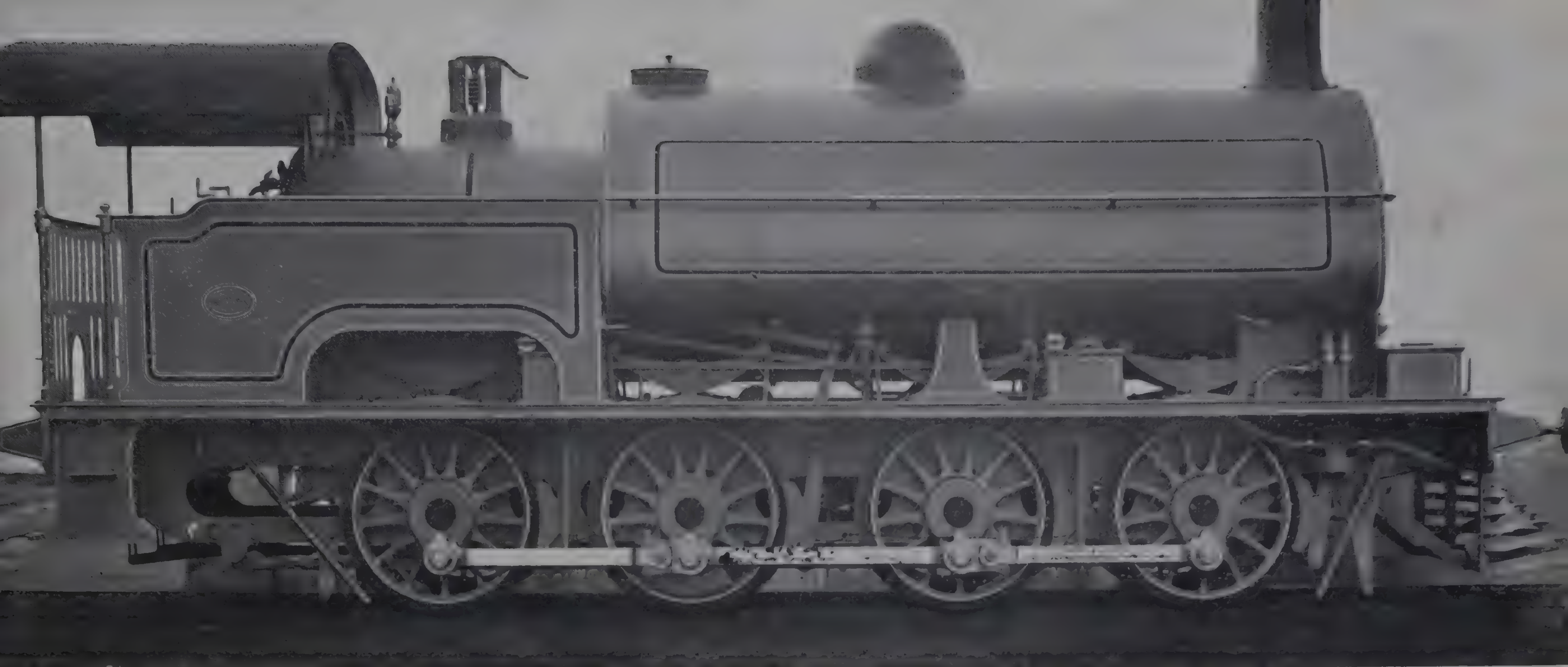
One of the '2-2-2 tank engines,' 'the Express,' imported by the East Indian Railway a little less than a hundred years ago, can be seen even today colourfully painted and preserved outside the Jamalpur Workshops looking the picture of utility and serviceability. Ever since then, the models, types and classes of locomotives imported into India for broad gauge, metre gauge and narrow gauge railways for passenger and goods traffic, run into a few hundreds. It is usual to divide locomotives into classes as well as into types. For instance, the Pacific type with a '4-6-2' wheel arrangement may be adopted for several different classes with different sizes and proportions. Thus, on the Indian Railways, Pacific type locomotives introduced between 1926 and 1930 for the broad gauge system, were of the 'XA,' 'XB' and 'XC' classes and for the metre gauge, 'YB' and

'YC' classes. This two-letter classification indicated at once the gauge and the group classification of the unit. The symbol 'X' was used to indicate the broad gauge and the symbol 'Y' for the metre gauge. The symbol 'A' referred to light passenger units, the symbol 'B' for medium passenger units, and the symbol 'C' for heavy passenger units. Thus, the combination 'YC' meant a metre gauge heavy passenger unit. In a hundred years, the number of different classes introduced has naturally been very large and the indicative abbreviations or symbol classifications have covered almost the whole gamut of the English alphabet. Before 1926, each railway group adopted its own classifications with a letter of the alphabet followed by a numerical suffix. The 'K' class locomotives, for instance, on the ex-Great Indian Peninsula Railway ordered in eight consecutive groups, each with some modifications, were designated 'K1' to 'K8'. The first sets of IRS locomotives had classifications such as 'XA' 'XD,' 'YB,' 'YD,' 'ZB' and 'ZE' for the 5 feet 6 inches, metre, and 2 feet 6 inches gauges. After World War II, when a greater degree of rationalisation was found desirable, a simpler classification was adopted. The letters 'W,' 'Y' and 'Z' have been employed respectively for the 5 feet 6 inches, metre, and 2 feet 6 inches gauges with the letters 'P' for passenger locomotives, and 'G' for goods locomotives. Thus, the 'WP' is the standard broad gauge passenger locomotive.

CLASSES AND MODELS

When it is appreciated that the whole Indian Railway system has been built up gradually by several different companies with different consulting engineers, each planning for the particular requirements of their own terrain, it is not surprising that a very large diversity of classes has come into being. In 1923, there were over 500 different classes of locomotives in the country, with a wide variation in wheel arrangements, wheel sizes and axle-loadings. The deliberate policy of standardisation and rationalisation undertaken between 1923 and 1930, had resulted in a moderate reduction of the classes to 377 by 1952. It is expected that a further rapid reduction will occur during the next 15 years as a result of intensive efforts at rationalisation following the Second World War.

In tracing the evolution of the Indian locomotive, particularly with respect to its design and construction, it is not necessary to consider in detail all the various types which have been imported from time to time. It is sufficient to study a few basic factors such as the growth in speed, the reduction in fuel consumption and the ability to operate on more moderate grades of fuel; the progress in balancing and stability in movement; and specialisation in service owing to the development of traffic along certain lines. From this point of view, the Indian locomotive has been gradually emerging as a unit built primarily for Indian conditions and, though it inherits most of its features from its predominantly British tradition, it now has a character of its own.

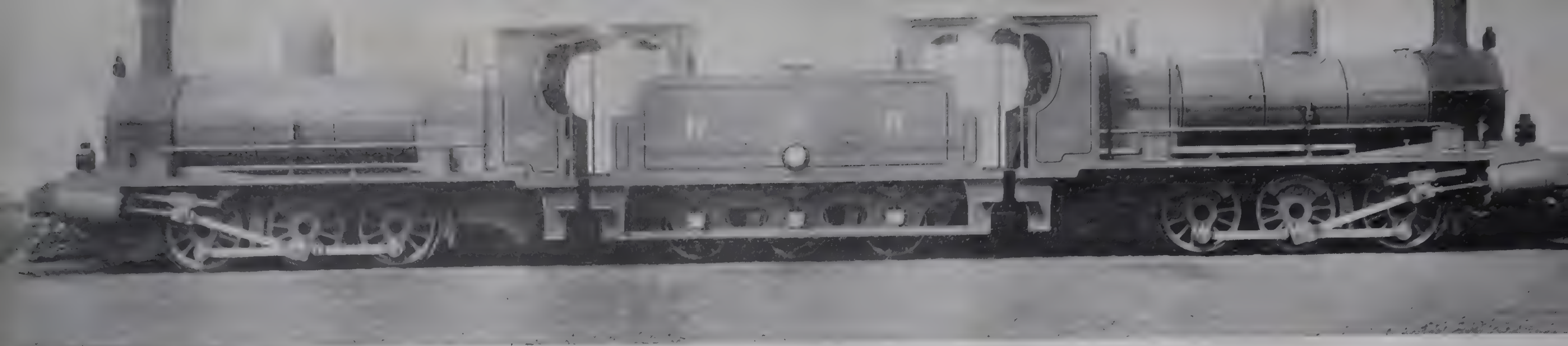


Above : The G.I.P. Railway which had a heavy ghat section to negotiate between Karjat and Lonavla and Kasara and Igatpuri required high tractive effort locomotives as far back as 1879. The W class locomotive illustrated was the eight coupled unit with saddle tanks. Some of these units were still in operation at the end of World War II.

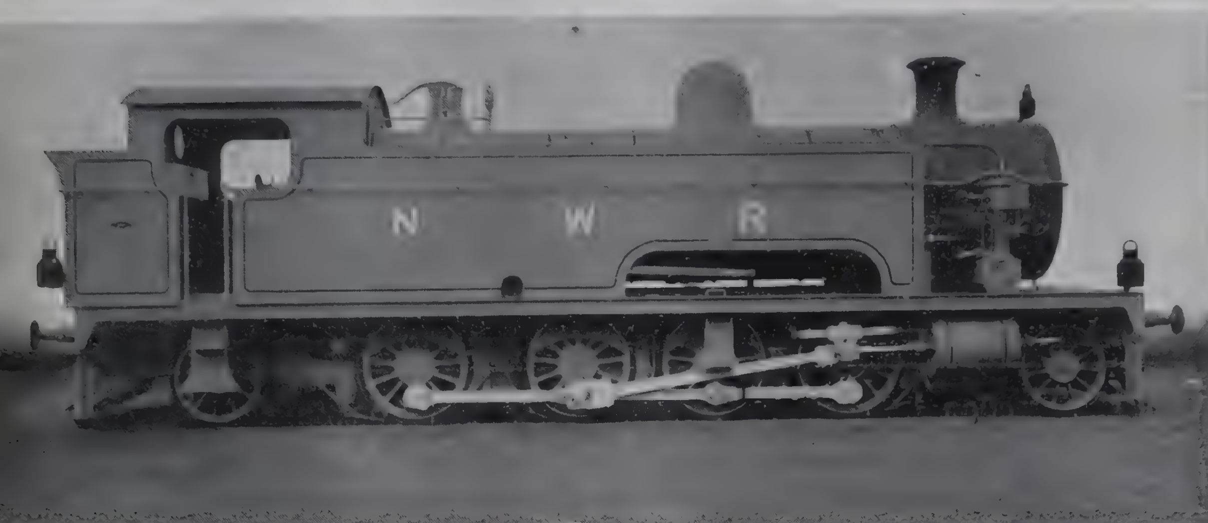
Below : The 4-6-0 locomotive illustrated was one of the first units with this wheel arrangement used in India. This unit with 18″×22″ cylinder and 51″ wheels made its appearance in 1885.

Below : Another view of the 4-6-0 locomotive described abov .

Below : The unit illustrated is a later version of the 4-4-0 wheeler engine first introduced in 1877. The particular unit was put into service in 1887.

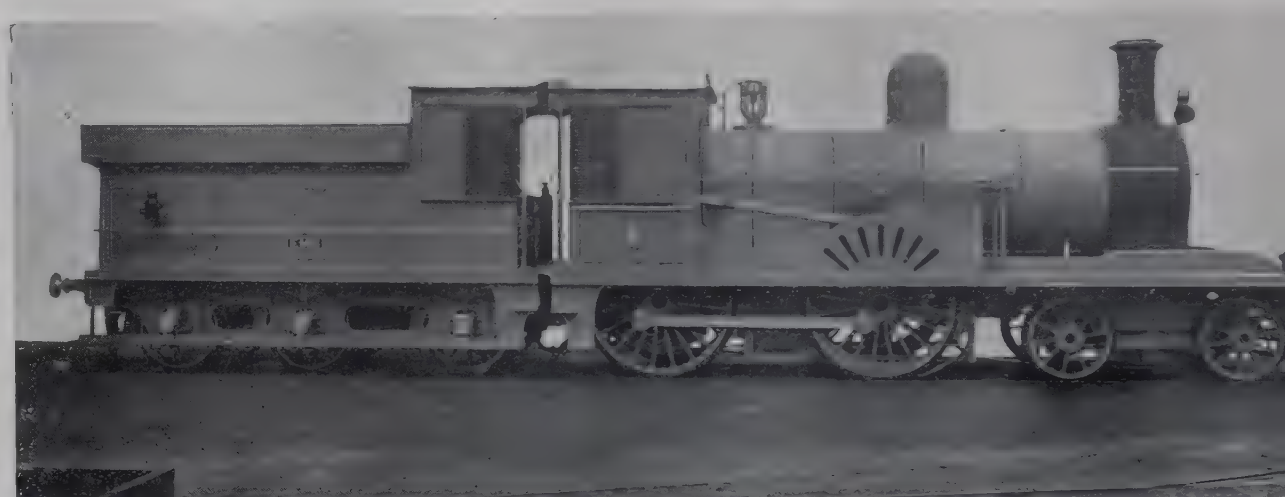


Above : An extremely interesting arrangement for coupling locomotives back to back used on the North Western Railway in 1888 for operation on very heavily graded sections.



Left : This 2-8-2 tank locomotive was used for heavy shunting on the North Western Railway from 1896.

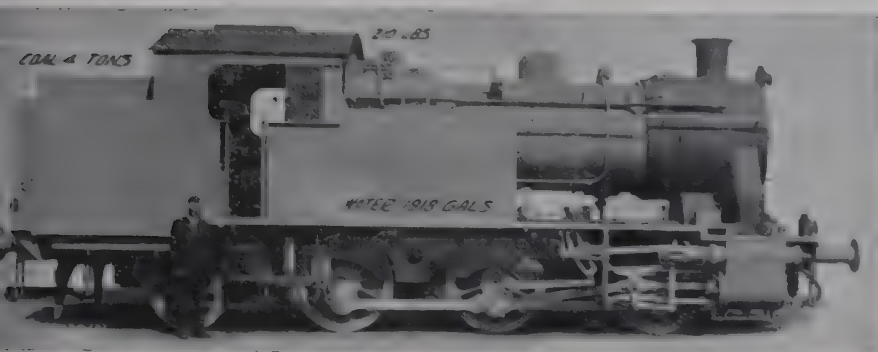
Right : This 4-4-0 class locomotive introduced in 1898, though still employing inside cylinders, is an interesting development on the 4-4-0 class illustrated elsewhere and is representative of the period 1877—1887. The unit shown belonged to the Bengal Nagpur Railway.



Left : Another picture of the D class 4-4-0 locomotive on the B.B.&C.I. Railway. The unit shown was used on the occasion of the visit to India in 1921 of the Prince of Wales.

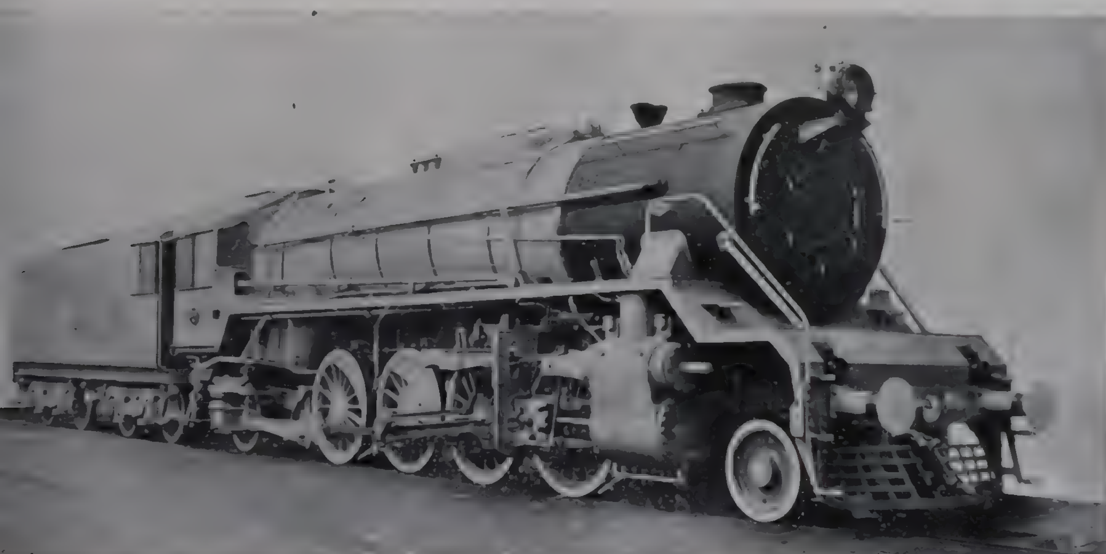
Below : The Atlantic type of locomotive illustrated here was one of the earliest with this wheel arrangement in the country.

Above: The unit shown is one of the earliest articulated types of locomotives employed in India. The Bengal Nagpur Railway has since introduced heavier garrat locomotives for mineral traffic over gradients.



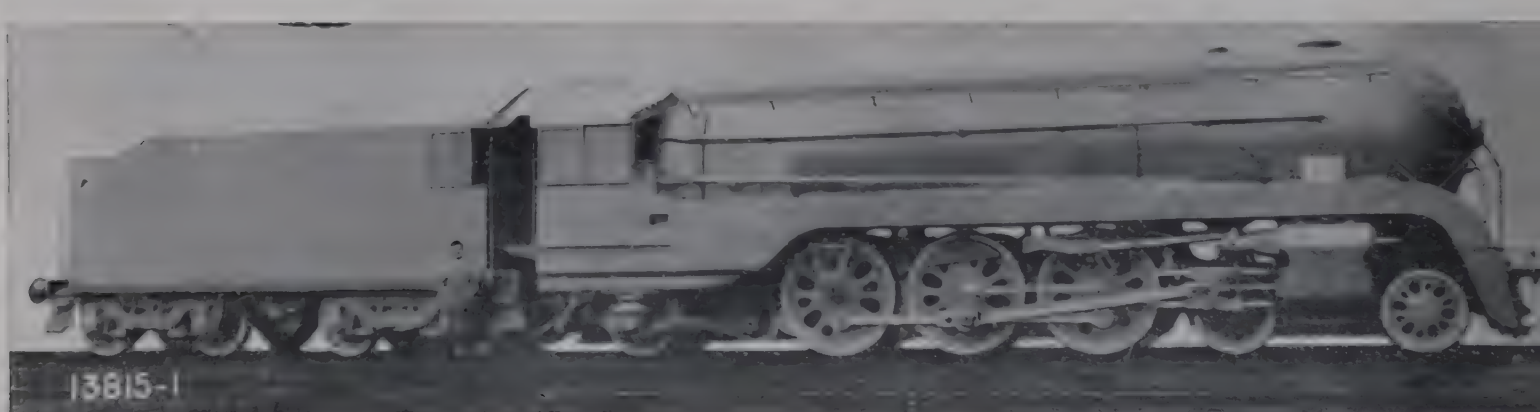
Above : The WW class, a standard light shunting locomotive for particular use in passenger units.

Above : The WM class, a medium shuttle service locomotive for high acceleration with loads of 4 to 7 bogies and maximum speeds of 65 miles per hour.

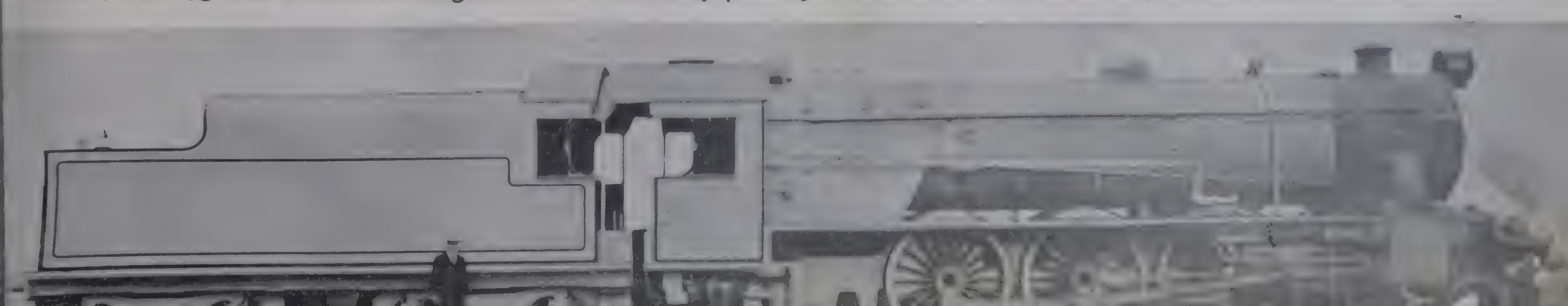


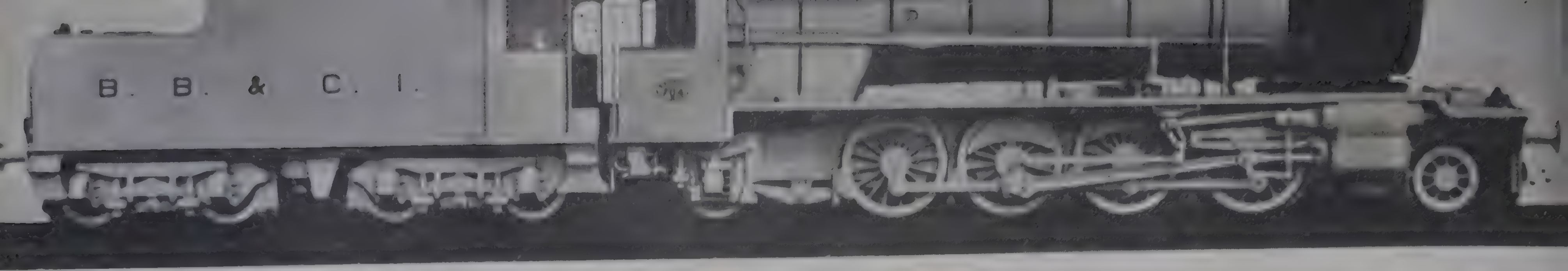
Left : The WG locomotive. This post-World War II design of goods locomotive replaced the XD of the 1928 standardization. It can handle loads up to 15 per cent larger than those of the XD class and is considerably more economical in fuel. It takes a common boiler with its sister engine the WP which is the standard for passenger services.

Below : The WP class locomotive built as the standard passenger unit in the post-World War II scheme for rationalization, has already made its reputation on Indian Railways as a free steaming and riding unit with plenty of power for good time keeping.

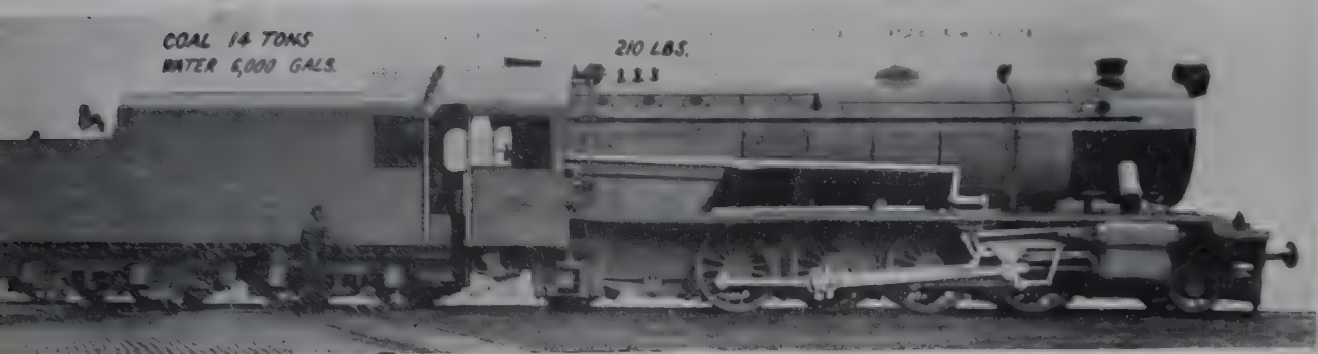


Below : The XC class locomotive designed in 1928 for heavy passenger work in the first scheme of IRS locomotive standardization.



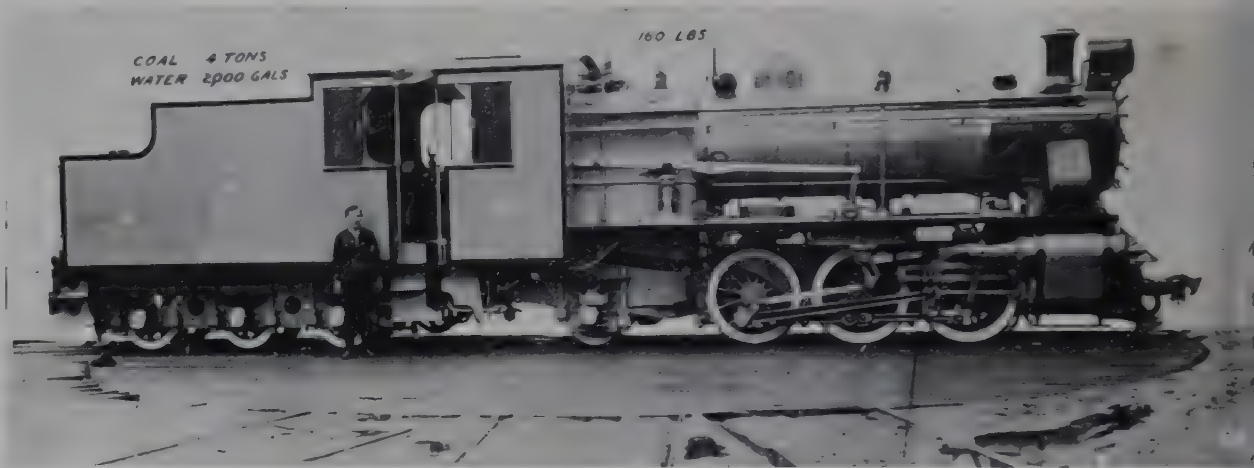


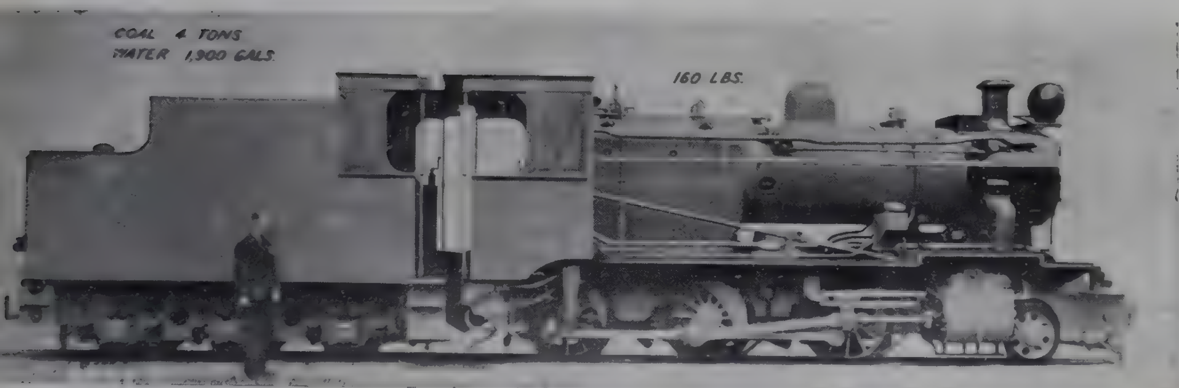
Above : The XD medium class goods locomotive designed in 1928. This was the IRS standard locomotive, limited to a 17 ton axle load for wide use with loads up to 2,000 tons.



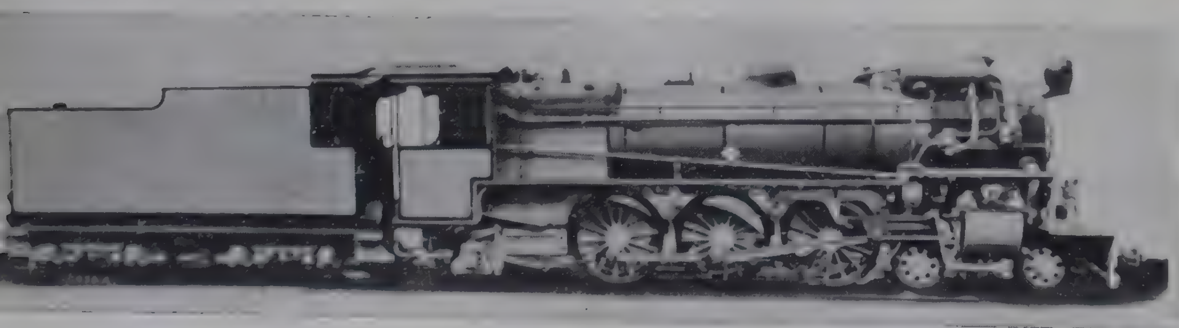
Left : The heaviest goods locomotive XE class of the first IRS standardization. Designed in 1928 for mineral traffic this locomotive operates over limited areas which can accept a 22½ ton axle load, and has large moving dimensions, hauling loads of over 2,200 tons on moderate gradients.

Right : This YF class metre gauge locomotive has been built for light track which can accept a 8-ton axle load. It has a large grate to assist it on moderate gradient.





Left : The YK class locomotive is a light passenger locomotive for use on 42½ lb. track.



Left : The YB class locomotive has been standard passenger locomotive on the metre gauge for 22 years. The unit shown in the diagram has poppet valve gear and ACFI type water heater.

Below : The YG class locomotive the standard metre gauge unit for goods operation on all tracks with 50 lb. rails or heavier. Its large boiler permits the development of a high power which will encourage higher speed goods operation.

In countries like America and Russia, where the traffic is dense and long distances have to be traversed between important centres, locomotives have been designed and constructed for the haulage of the heaviest loads at high speeds, that is, the units are built for very high horsepowers. On the continent of Europe where traffic is also dense but where important centres are relatively close together, locomotives are designed for higher acceleration, and smaller loads and higher speeds become worth while. The European locomotive is generally of a lower power than the American or Russian unit. Indian traffic for some years will have a character midway between that of the European continent and that of the American railways.

The locomotive and the track engineers have to work in co-operation to co-ordinate the stresses in the track and the development of the permanent way with the haulage needs for traffic operation. It is usual to define a limitation for the axle-load of a locomotive or the weight under any axle. This specified maximum weight is determined by the kind of track and rails and the weight-bearing capacity of bridges, viaducts, etc. The good locomotive designer attempts to get as much power and tractive effort as he can within the limitations of moving dimensions and axle-load prescribed by the civil engineer. He strives to distribute the weight of the locomotive, so as to produce the minimum stresses in track. The wheels of the locomotive, as mentioned earlier, are grouped as carrying wheels which do not contribute to tractive effort, and the driving or coupled wheels which are immediately driven by the cylinders. The weight below these coupled wheels is referred to as the 'adhesive weight'. As the friction between wheel and rail ultimately limits the tractive effort a locomotive can exert, it will be appreciated that the design of a locomotive is largely dependent upon the limitation of axle-load, and the ability to provide within that limitation a maximum adhesive weight. It is also important particularly with the lower grades of coal available for use in India, to provide a large capacity boiler. This results in the need for carrying wheels to assist in carrying the increased weight of the superstructure without exceeding the limits of axle-load.

LOCOMOTIVE WEIGHTS

It is interesting to reflect on the growth of weight of locomotives from their earliest days. 'Old Iron Sides,' for instance, one of the first American locomotives in regular service (1831) weighed five and half tons, whereas the modern freight steam locomotive of the American continent weighs in working order 853,000 lb. Some of the American monsters have a length over buffers well over a 100 feet, which may be compared with the modest 20 feet of the earliest locomotives used in India.

IMPROVEMENTS

The old reciprocating engine, as it was called in technical parlance, has seen

during the course of a century, a large number of important improvements, some of which have come to stay in all areas of the world. Others have been introduced only in particular countries to meet special conditions. The introduction of superheaters, the use of multiple expansion in some cases combined with condensing, high pressure boilers, feed water heaters or pre-heaters, improved valve gears and a number of other developments, have gradually made the modern steam locomotive what it is. The urge for greater and better power has also driven railways in some countries to adopt new forms of traction. In America, for instance, which has witnessed the largest developments of the steam locomotive, there is now a transition from steam to diesel locomotive power, and in areas where the density of traffic warrants capital expenditure for the change, electric traction is superseding other forms of power. Even the system of propelling locomotives by applying engine power to turn the wheels and the reliance on adhesion for tractive effort—a principle which had hitherto been thought basic and inevitable for all types—can now be superseded, though practical developments in this direction are still in the experimental stage.

THE RAIL ZEPPLIN

In the early nineteen-thirties, a machine made its appearance on the permanent way in Germany in which the principle of adhesive weight played no part whatever. It was called the 'Rail Zepplin,' and was driven by a large aeroplane propeller placed at the end. It could develop a speed of more than 140 miles per hour. It had graceful stream-lines and everything adapted to fantastic speeds, not to mention the air crew. The Rail Zepplin was designed by a German engineer, Kruckenberg. During the first trial run made on the track near Hanover, it reached a speed of 144 miles an hour. Before the war another German Professor Dr Weisinger of Zurich, was reported to be working on new models for a Super Rail Zepplin with which he hoped to attain a speed of 225 miles an hour.

In terms of speed, the modern steam locomotive built for express service can cruise at speeds above 90 miles per hour. One British locomotive, the Mallard, holds a speed record exceeding 125 miles per hour. The following surprisingly good performances of certain British locomotives during the last twenty years will indicate the progress made from the early days when steam locomotives had to be preceded by runners carrying red flags. The British L.M.S. locomotive 'Coronation Scot' on 29th June 1937, covered a distance of 158 miles in 1 hour and 59 minutes, attaining during the run a maximum speed of 114 miles per hour. In 1935, the 'Silver Link,' maintained an average of 100 miles an hour. In 1936, the 'Princess Elizabeth,' hauled a train of eight coaches over the distance of 401·4 miles from Glasgow to London over partly mountainous country in 344¼ minutes, an amazingly good long distance performance on an ordinary, unprepared track.

INDIAN DESIGNS

In India, speeds of this order are not attempted and locomotive designs have been determined principally by considerations of fuel quality and fuel economy. The earliest locomotives which originated in Britain were built to operate on British coals. But from 1900, when the collieries in Bengal began to produce indigenous coal, the imports of coal for steam traction have ceased. Up to 1930, railways in India were burning only the best grades of Indian coals. But more recently it has been realised that there is need to conserve the highest grades of coal, available supplies of which are limited, for metallurgical purposes. Indigenous coals now available for railway use are of a non-coking variety with an incombustible content of 18 to 26 per cent and with calorific values ranging from 12,600 BTU/lb. to 11,000 BTU/lb. The use of such coals in supersession of the originally imported coals with calorific values exceeding 14,000 BTU/lb. has resulted in a considerable increase in consumption of fuel and a reduction in the power/weight ratio of Indian locomotives. This explains why greater attention in India must be paid to economy in fuel. It also throws light on the need for the considerable transformations and adjustments necessary in Indian locomotive designs. This has influenced also the general outlook in the choice of power and has persuaded Indian engineers to examine the economics of electrification in several areas of the country, particularly where the lead from the collieries is great and where the traffic is dense. The diesel locomotive, which has been superseding the steam locomotive in America, has so far found very limited use in India owing to the negligible indigenous resources in oil fuel.

The earliest locomotives imported into India were simple in design, generally required smaller boilers and employed Stephenson's link motion for distribution of steam. They were built for very low axle-loads for the light tracks then laid down. These axle-loads were gradually increased in successive designs as the growth of traffic warranted the laying of heavier tracks. Some of the early locomotives were equipped with tenders, but many were tank type locomotives with limited coal and water. The cylinders varied in size from the 13″ × 20″ of the first 'Lord Falkland' and 15″ × 22″ typical of the locomotives imported in 1861 by the East Indian Railway. They had coupled wheels, former five feet in diameter and the latter six feet in diameter. A few of these locomotives had more than three axles. Arrangements such as the '2-4-0,' '2-2-2' and '0-4-2' were in common use.

COMPOUND EXPANSION

One of the most important earlier developments influencing the construction and design of locomotives was the use of compound expansion on engines. It was hitherto believed that French engineers were pioneers in this respect. This

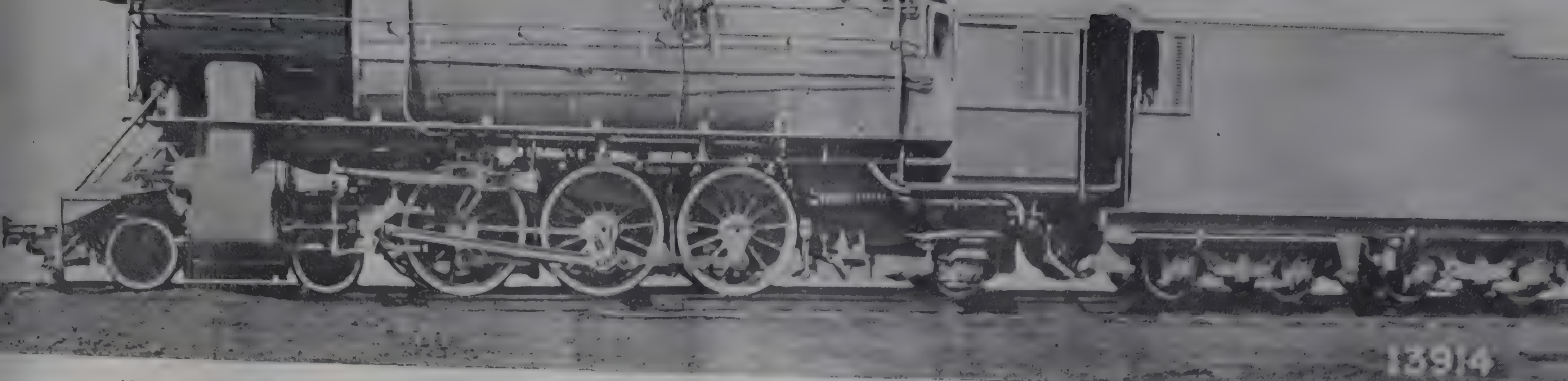
is not true. There is clear evidence on record that the compound expansion device on locomotives was first tried in India over seventy years ago. In his book, *The British Steam Railway Locomotive from* 1825-1925, E. L. Ahrons writes; 'In 1884. Charless Sandiford, then a Locomotive Superintendent on the North Western State Railway, altered a mixed traffic 2-4-0 engine replacing its 16″ × 24″ inside cylinders with 17″ cylinders and adding a pair of 11-3/4″ by 24″ cylinders outside. All four cylinders drove the same axle and the inside and outside cranks on the same side were at 180 degrees. The coupling rods were retained. At the same time, Sandiford converted another engine into a 2-cylinder compound using a cock to admit boiler steam to the lower pressure cylinder for starting. The drawings for both these engines were made in 1883 before the 2-cylinder Worsdell system was tried in the United Kingdom.'

Though locomotive engineers took enthusiastically to compounding in the later part of the nineteenth century, during the earlier years of the present century, there was a distinct tendency to revert to the traditional simple expansion principle, and important changes followed during this period and up to World War I in several other directions.

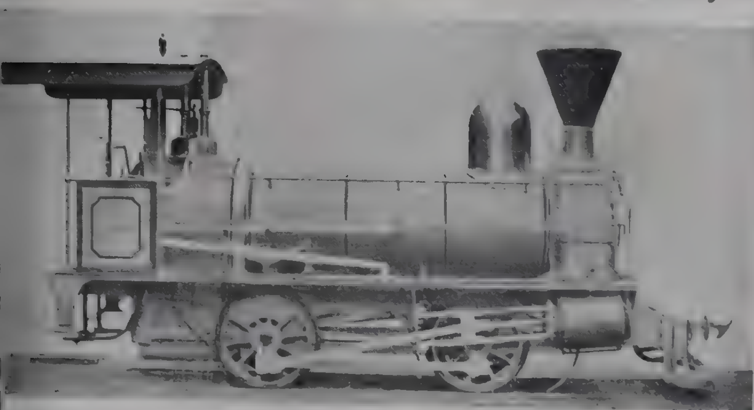
Early attempts at standardisation of locomotives made by the Government railways--then a small group along the Northern, Western and Eastern frontiers of the country, had not made great progress, as most of the company-managed railways had different ideas on the most suitable locomotives for their work. The first large-scale attempt at rationalising locomotive designs, and standardising features with a view to reducing purchase costs by bulk purchase, and reducing the number of parts for maintenance, was made in 1910, when the British Engineering Standards Association in consultation with Messrs. Rendel, Palmer and Tritton, then Consulting Engineers to the Government-managed railways, designed for India the 4-6-0 and 2-8-0 B.E.S.A. locomotives for the broad gauge and the 4-6-0 B.E.S.A. locomotives for the metre gauge. These classes were adopted largely on all railways. The main features of the new types were the abandonment of Stephenson's link motion and its replacement by Walschaert's valve gear as well as the standardisation of outside cylinders and the adoption of simple expansion. The locomotives were partly compensated on their spring rigging which was of the underslung type for the coupled axles. These locomotives have borne the main burden of Indian Railway traffic for over thirty-five years and many of them are still in use and capable of good work.

SUPERHEATING

Superheating, which is possibly the most important development in locomotive construction since George Stephenson's day, was introduced in some of the countries of Europe before and during World War I. The advantages of this invention were so pronounced that large schemes of conversion of older



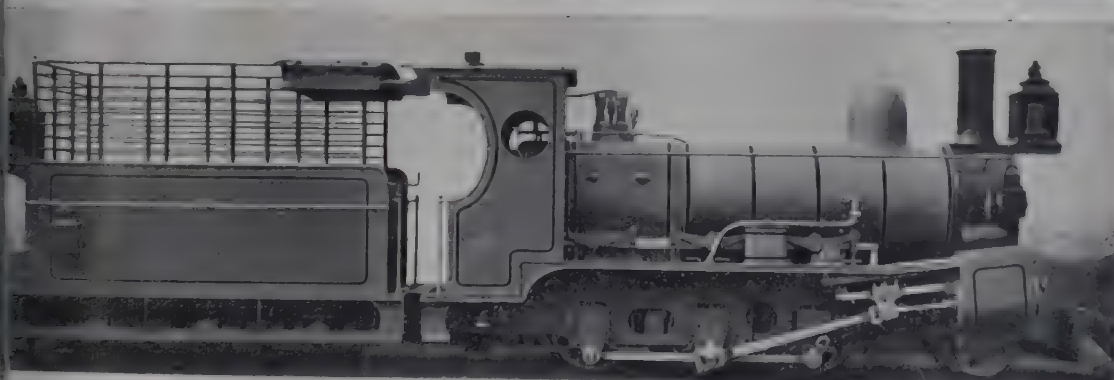
Above : The YP class locomotive is the sister engine of the YG class locomotive, taking the same boiler and tender. This unit is the standard post-World War II unit. for metre gauge passenger service and has been tested to speeds over 60 miles per hour for its stability in riding This unit is powerful, rides well and is economical in fuel.



Above : A type of locomotive introduced in 1873. The unusual position of the dome may be noted.

Above : One of the early types of Metre Gauge locomotives built in 1873 which in slightly modified form served the Metre Gauge system for many years, and many locomotives of similar design are still in service.

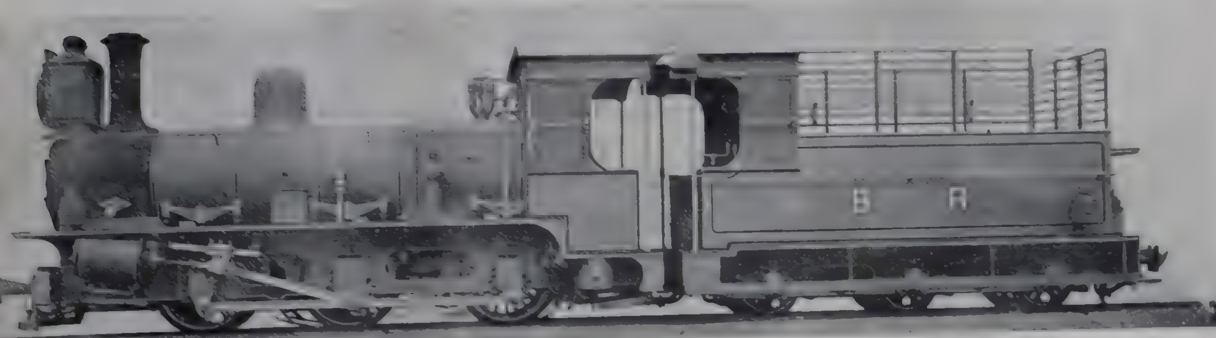
Left : This passenger locomotive, built in 1880, is designed for burning wood fuel and is fitted with a spark arrester on the chimney. This locomotive with its decorative painting was, no doubt, the pride of the railway when it was first introduced.



Left : A goods locomotive introduced in 1881. From the tender framing it will be seen that this locomotive was also intended to burn wood fuel.

Below : In this locomotive, built in 1882, is introduced a leading bogie. This type of locomotive worked the crac passenger trains of the 1880.

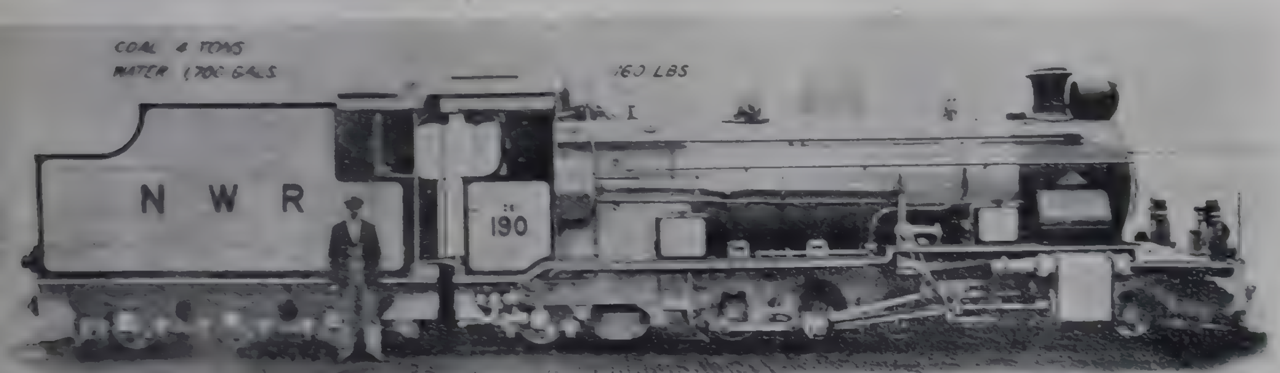
Above : In 1901 locomotives began to be more modern in appearance. Here is an example of a 4-6-0 passenger locomotive built for the B.N.W. Railway,



Above : An 0-6-0 locomotive used for Mixed Traffic having Stevenson's Link Motion and with a tender design for wood fuel was built in 1902. Many locomotives of this design are still in service on Metre Gauge Railways.

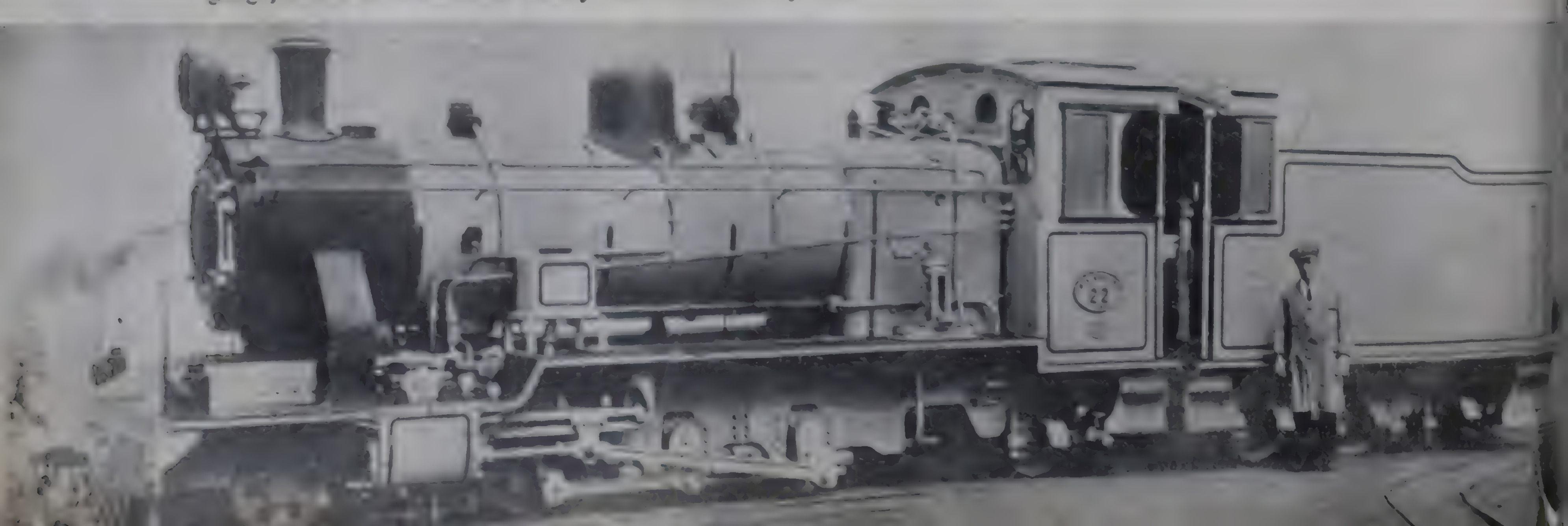
Above right : The 0-4-0 tank locomotive used on the 2′-0″ gauge, Darjeeling Himalayan Railway, was put into service 70 years ago.

Left : A 4-6-4 tank locomotive, used on the 2′-6″ gauge of the B.N. Railway very early in this century.



Left : The ZE class locomotive was built for goods operation on the 2′-6″ gauge on which it has been a standard unit for 22 years.

Below : The ZB class locomotive is the standard passenger unit for the 2′-6″ gauge, on which it has been widely used for over 20 years.



locomotives, were undertaken in Indian Railway workshops. By 1922, a large measure of conversion had already been undertaken, and superheating became a standard feature of locomotives in India.

During the twenties of the present century, a further step was taken towards rationalisation and standardisation. The steps taken in 1910 had certainly resulted in reducing the types of locomotives in use on Indian Railways, but in subsequent years, all this good work was undone when several railways began introducing their own little changes and improvements to the standard B.E.S.A. classes. By 1922, a stage had been reached when though basically similar in wheel arrangement and valve gear detail, there were 500 different types of locomotives in use in India. Experts were unanimously of the view that for improved performance and greater economy, a large measure of rationalisation and greater standardisation of types against specific duties such as the light passenger, medium passenger, light goods, heavy goods, and shunting, had not only become desirable but imperative. By 1925, the East Indian and the Great Indian Peninsula Railways were brought under Government control. This momentous administrative change lent further incentive to plans for greater rationalisation and standardisation. During this period again, railways in India were passing through a period of abundant prosperity and seemed responsive to new ideas. It happened to be also the time when in countries like France, Germany and Russia, standardisation in various directions was being introduced.

STANDARDISATION

In Russia, where railways had been nationalised under the Soviet regime, construction of locomotives had been taken in hand under the first five year plan for which purpose standard types had to be evolved. The two predominant standard designs of this period were the 'J. B.' (Joseph Stalin) passenger traffic class and the 'F. D.' (Felix Dzerzhinsky) freight traffic class. The former had '2-8-4' wheel arrangement, developing up to 3,000 horse-power and capable of a maximum speed of 78 miles per hour. The latter had a '2-10-2' wheel arrangement, developing to a maximum of 3,100 horse-power, with an average speed of 25 to 28 miles per hour, able to handle goods trains of 2,500 tons.

In France, even though nationalisation came in 1938, standardisation in respect of locomotive designs had started much earlier. By the thirties, the various engines of widely diverse types and origin had been rebuilt or converted in accordance with the general basic principles of the Paris-Orleans Pacifics. Germany had also been making great strides with the co-ordinated standardisation of locomotives, rolling-stock and track. The four-cylinder '4-8-4' standard locomotives of the German State Railways gained considerable fame. They were equipped with two sets of Walschaert's valve gears between the frames, the outside valves being driven through rocking levers. German engineers had also

been experimenting with the use of pulverised fuel on locomotives and had reached a fair measure of success with fuels containing less than ten per cent ash.

India, which had always leaned towards standardisation and had already made considerable advances in the introduction of the B.E.S.A. locomotives from 1910, made a detailed review of the possibilities of a co-ordinated and rationalised development of track, bridges and rolling-stock from 1923. Standards were laid down for the moving dimensions and the maximum axle-loads for broad and metre gauge tracks, both on main lines and branch lines, and outline designs were prepared for a set of locomotives to cover the most important services. These locomotives were designed to operate on moderate grades of Indian coal instead of the expensive high quality coals, which had been necessary for the earlier classes of locomotives. For this purpose, the locomotives had to be provided with larger grates which added to their weight. These heavier locomotives had, therefore, to be built either with a higher axle-load or with a large number of axles.

TESTING PERFORMANCE

In 1931, a broad gauge Dynamometer Car was put into service to collect basic data on the resistance of Indian rolling-stock and the rating and performance of Indian locomotives. A few years later an Oscillograph Car was put into service to study the riding qualities of coaches and stresses in track. As a result of this research, a large amount of valuable data were collected, and the new ideas were embodied in subsequent builds of locomotives which became better adapted for use in India. The newest locomotives which incorporate the fruits of this research have marked improvement in riding qualities and are capable of using moderate grades of coal economically. Unfortunately, there was a long period of depression from 1931, and Indian Railways found it expedient to limit the purchase of new locomotives, and to concentrate instead on the more intensive use of existing classes. This policy met with considerable success till the beginning of World War II, when the sudden growth of traffic found the country short of sufficient locomotive power of the right type.

The position became serious towards the end of World War II, but was relieved by the import from America and Canada of a little over 1,000 locomotives built as the American equivalents of the earlier Indian standards of the 'XD' and 'XE' classes. These American classes of locomotives represented the first large scale introduction of American features into Indian railway practice. These features were carefully scrutinised by the Locomotive Standards Committee which advises the Railway Board on features worth standardising. Several of the features of these new locomotives found their way into the standard specifications for post-war designs, and Indian locomotives began to lose their predominantly British character.

POST-WAR DEVELOPMENTS

The post-war Indian locomotives have been built particularly for Indian conditions and fuels, and are particularly adapted for use on existing Indian tracks. The engineers responsible for their design have deliberately avoided the use of high axle-loads so as to save expenditure of money and steel in the strengthening of track and bridges. The maximum axle-load employed in new classes has been limited to 18½ tons and special consideration has been given to the riding characteristics of the locomotives, though provision has been made in the new designs for considerable increases in power and potential increases in speed during the forty years life of a locomotive. Valve gears, though still of the Walschaert's type with piston valves have been improved in proportion. Boilers have been increased in capacity to cope better with lower grade fuels and superheat temperatures have been stepped up.

The earlier standard locomotives were found on dynamometer trials to consume 19 to 20 lb. of steam per horse-power-hour. The new standards, because of their higher degree of superheat and their better steam distribution, consume 16 to 17 lb. of steam per horse-power-hour and have in fact under their most economical conditions touched steam rates below 15·5 lb. per I.H.P. hour. Boiler efficiencies for any given grade of coal have been proved to be considerably higher than for any previous locomotives. Large capacity ashpans have been accommodated to deal with the higher ash content of the coals now used. But in spite of these developments the new designs retain the traditional simplicity of Indian locomotives and have been built robustly for low maintenance and reliability, rather than economy in fuel as the principal objective. They have, however, been built with ample power to cope with some advances in loads and speeds during their useful life.

The new classes are particularly remarkable for the degree to which standardisation has been carried in their design. The goods and passenger units have interchangeable boilers, tenders, axle boxes, springs, boiler mountings, valve gears and cabs, and a large number of minor features. The general construction of the broad and metre gauge units is similar, so that maintenance practices may also be standardised. It is visualised that nine classes of the broad gauge and six classes on the metre gauge can serve all the Indian Railways without sacrificing service specialisation on a basis of duties, so that, as more of these classes are introduced in replacement of older classes, it is hoped that the total number of different classes of locomotives in India may be reduced in time to less than 50. This figure may be compared with the 500 different classes in use during 1925 and the 377 classes in use in 1952.

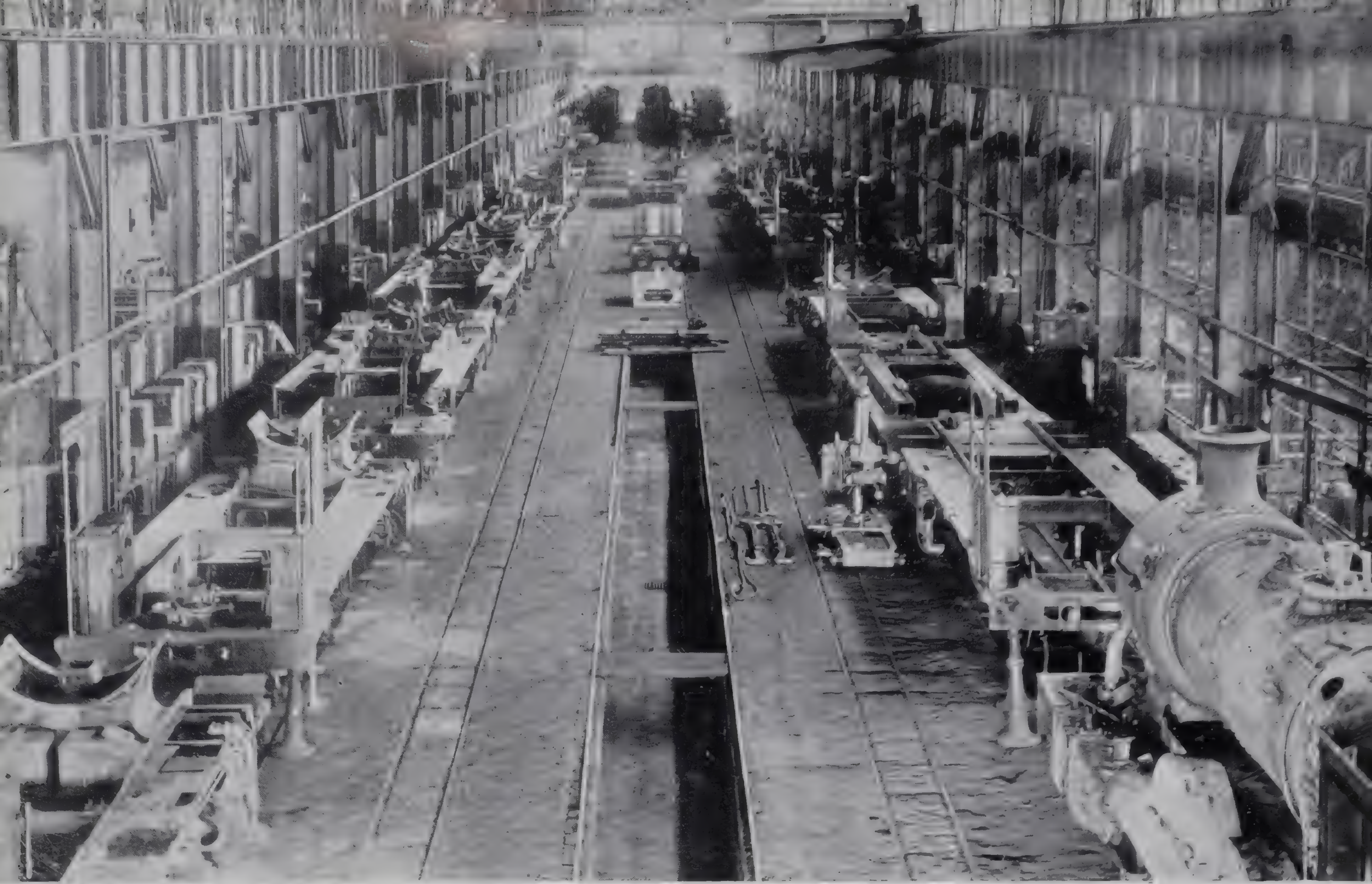
India has also adopted other forms of traction in certain areas. Electric locomotives have been in operation over the Ghats from Bombay to Poona and

Bombay to Igatpuri, the main source of supply being the hydro-electric works in the area, supplemented by a thermal station. In certain areas, particularly remote from the collieries, diesel locomotives have been handling certain work. Greater developments in electric traction and dieselisation may be expected in the future with the growth of the multi-purpose schemes on the one hand and the proposed oil refineries on the other. But in the main, the steam locomotive in India will continue to hold the field for many years. An important development in this connection during the last three years has been the actual manufacture of locomotives of the most modern type in India at the newly laid plant at Chittaranjan in Bengal and by the Tata Locomotive and Engineering Co., Jamshedpur.

Above left : Chola Power House, Kalyan.
Above right : Inside view of Chola Power House, Kalyan.

Right : The boiler repair bay at Dohad. An XC boiler is seen in the foreground.

Below : Golden Rock Loco, carriage and wagon repair workshop, Trichinopoly.



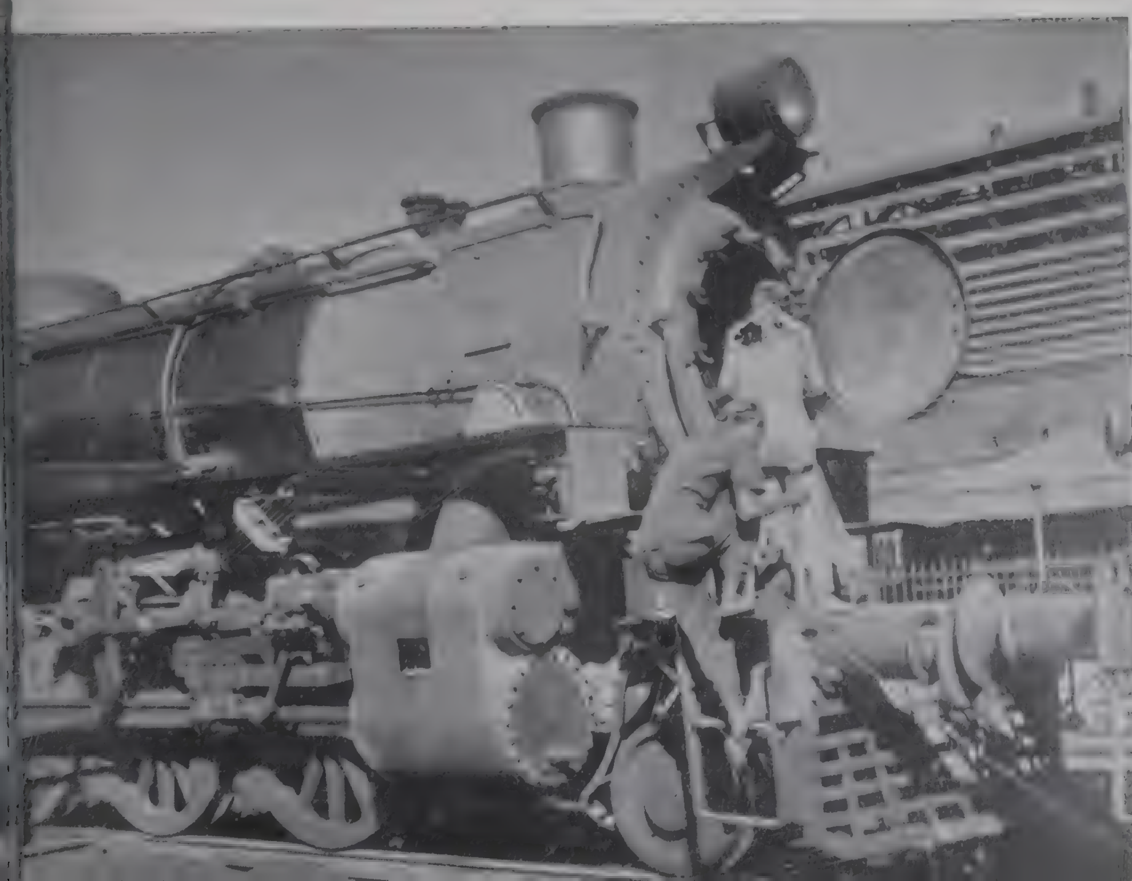
Above : Erecting Shop, Khargpur, prior to the belt system of repairs.

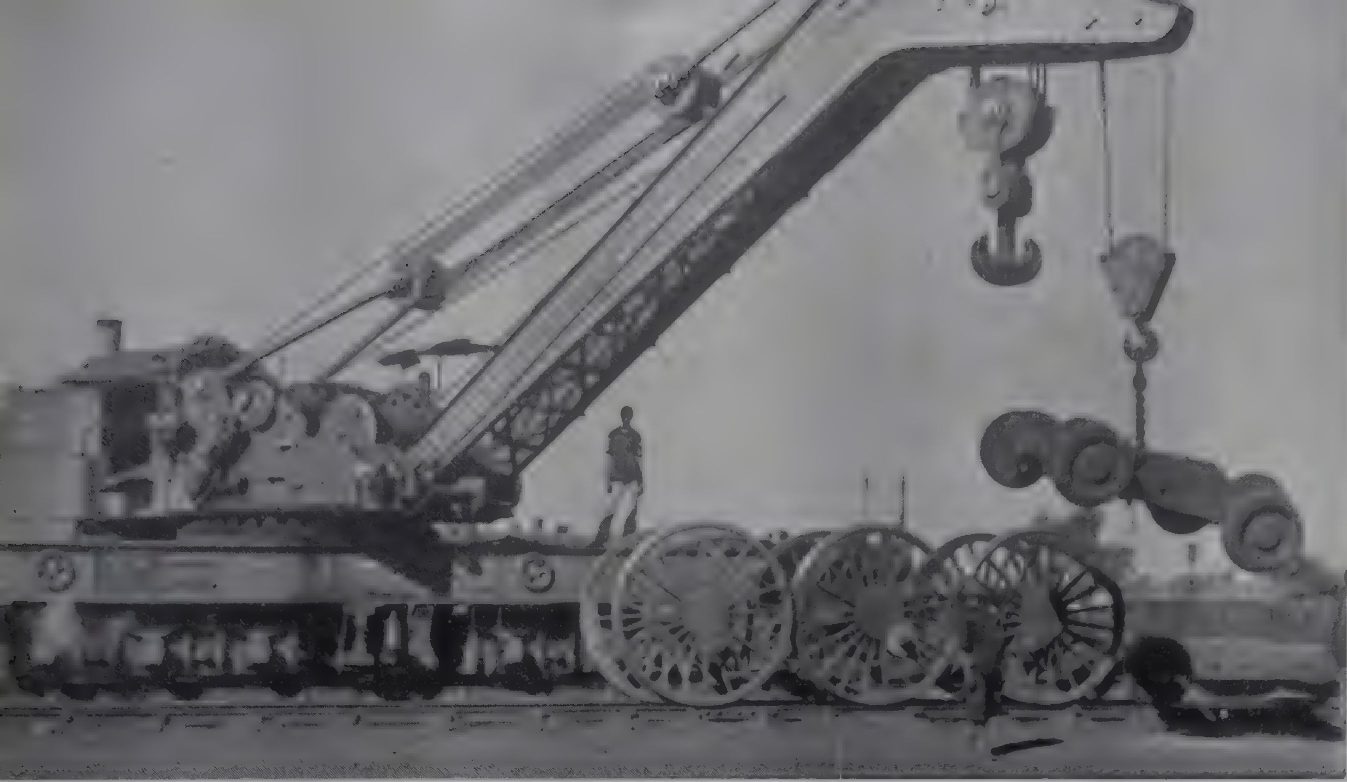
Below : Erecting Shop, Khargpur, after the introduction of the belt system of repairs.

Above left : Front view of a running shed.
Above right : Engine returns after a trip and undergoes inspection.

Right : Coal is replenished.

Below left : Smoke tubes are cleaned.
Below right : Engine is lifted with the help of hoists for attention to wheels and bearings when necessary.





Left : View of the 65-ton crane in operation.

Right : 65-ton Travelling Crane helps in heavy lifts.

Below left : Engine is cleaned with the help of a strong spray.
Below right : A portable grease gun in operation.

XIV. Keeping The Wheels Moving

THE average man today gets into his railway train with less anxiety and fear than his eighteenth century ancestor while mounting his favourite horse. His only concern is to be able to get a comfortable seat: his major fear that he should not arrive at his destination later than the scheduled time. Few people give a moment's thought to the fact that a railway train is a complicated mechanism; that its ability to make a safe journey at the high speeds required to keep to schedule, depends upon the precision, care and research, which have gone into the construction of a thousand and one component parts which make up a locomotive: the coaches, the permanent way, the signalling devices and so forth, and their proper functioning. When a passenger arrives at a terminal station and finds his seat reserved; a clean compartment awaiting him, and the entire train consisting of a dozen or more bogies, a monster locomotive puffing out steam, looking like a giant race-horse, fuming and straining at the tether, and ready to move at 50, 60 or 70 miles an hour, with the mere pull of a lever, his thoughts are more of the journey and the thrills of a changing landscape that it might offer; than of the effort, labour and vigilance expended before his arrival, to place this miracle means of travel at his disposal. He little realises that thousands of men have worked in dozens of factories and workshops all over the country to repair and renovate the locomotive and to keep it in fine trim, to see that the coaches are clean and neatly painted, that the shutters and panes are in perfect condition; that the cushions are comfortably springed; that the brakes and couplings are in order; and that the wheel alignments are correct.

All along the line there are thousands of gangmen who work on the track in order to maintain it in a condition fit to ensure safe and comfortable travel. Their work is apt to be forgotten because they are generally out in the blue, working under all sorts of conditions and weather. But it is due to this army of men who maintain the track that the standard of safety of travel on Indian Railways has been high.

Mention must also be made of the thousands of humbler wayside stations which fast trains rush past, leaving a cloud of dust, but where nevertheless staff

are posted to arrange for the reception and despatch of trains and setting of points and signals, etc,—all essential for the punctual and safe running of trains.

At important junction stations are located locomotive running sheds and carriage and wagons sick lines. In loco running sheds, locomotives after every trip are examined, cleaned, refuelled and receive running repairs including lubrication. At carriage and wagon sick lines, carriages are inspected, cleaned, washed, oiled and greased and attended to in respect of any defect noticed after inspection. Wagons too are inspected frequently in the course of their journeys and worked to sick lines when requiring attention to such parts which cannot be attended to in traffic yards.

Periodical overhaul to the rolling-stock is, however, carried out in workshops suitably equipped for the purpose and located conveniently to serve the rolling-stock belonging to each railway system. Considering the workshops, sheds and sick lines run and controlled by the Indian Railways, it would be no exaggeration to say that they represent one of the biggest industrial enterprises of the world.

EARLY WORKSHOPS

This colossal industrial system, grew from very small beginnings. When the railways first started, it was felt that since only minor repairs would be possible in India, all spare parts including even nuts and bolts, especially for locomotives, would have to be imported from England. For the purpose of minor repairs, a small Loco workshop was started by the Great Indian Peninsula Railway at Byculla in 1854. On the East Indian Railway greater enterprise was shown by the engineers under the compulsion of unexpected necessity. By a series of unfortunate accidents the first locomotive was misdirected to Australia, and the ship bringing the first coach models sank in the sea. It, therefore, became necessary to construct the coaches in India. This encouraged the hope that with local workmen and resources it should be possible to build future coaches in the country. On the East Indian Railway a Locomotive and Carriage shop was set up at Howrah. It was soon discovered that both in terms of the magnitude of the work involved and the type of trained labour required, Howrah did not offer the necessary facilities, nor the potentialities of space required. A very much larger Loco and Carriage workshop was, therefore, constructed at Jamalpur in 1862.

In western India, besides the Loco workshop started by the Great Indian Peninsula Railway in Bombay, the Bombay, Baroda and Central India Railway set up a workshop in 1856 at Amroli, near Surat. The relics of this workshop are still to be seen on the northern bank of the Tapti River near what is now known as Utran Station. Historical importance attaches to these works, since they were located near the very place where the British first landed on Indian soil and built their settlement at Surat. The Amroli Workshop was a simple wooden gable structure. The principal machine tools, all made in England, which formed the

major equipment of the workshops at Byculla, Howrah and Amroli were, engine lathes, boring, drilling, slotting and shaping machines; hydraulic and mechanical presses, screw jacks and hoists, together with a miscellaneous collection of track laying implements. All machine tools were prime-moved by steam power furnished by engines driving line shafts by rope drives.

RAILWAY TOWNS

In 1862, at the very time when the workshop at Jamalpur was taking shape, an area of 35 acres was acquired in the vicinity of Bombay at Parel and work was taken in hand for the construction of an up-to-date loco workshop where major repairs could be undertaken. These two enterprises mark the beginning of an important phase in railway engineering. Numerous big and small railway workshops have since grown up all over the country, equipped with some of the latest machine tools not only to repair locomotives, wagons and carriages, and everything else connected with the operation of railways, but also to manufacture most of the component parts required for the purpose.

Broad, metre and narrow gauge workshops exist all over the country, the more notable are the workshops at Parel, Matunga, Dohad, Jamalpur, Khargpur, Lillooah, Kanchrapara, Perambur, Golden Rock, Charbagh, Ajmer, Gorakhpur and Hubli. The workshops at Parel, Matunga, Perambur, Charbagh, Ajmer, Gorakhpur and Hubli are located in large towns. Jamalpur, Khargpur, Golden Rock, Dohad, Kanchrapara and a few others were rural sites selected for workshops. The existing towns grew around them in due course. These are essentially what may be called Railway Towns. The Jamalpur Workshops occupy an area of nearly 150 acres and the town is spread over several square miles. The same is true of Khargpur, Golden Rock, Dohad and Kanchrapara.

SELF-SUFFICIENCY

In the early stages almost all spare parts for the maintenance of rolling-stock were imported from Britain but to attain self-sufficiency, their manufacture was gradually developed in the railway workshops and other indigenous factories. This has helped in the growth of a large number of ancillary industries. Railway workshops have afforded a wonderful opportunity to thousands of workmen to receive training in operating delicate and complicated machines, thus making trained labour available for other industrial enterprises in India. Above all, they have helped to create conditions whereby India is in a position to manufacture complete locomotives, coaches and wagons.

During the two world wars these workshops were not only carrying on their normal functions of repair, but were also exploited for substantial assistance to coaches and for a variety of other subsidiary equipment which would otherwise have had to be imported from abroad.

Since the development of electricity, railways have had to generate their own power resulting in a large number of big or small power houses all over the country. Some of these power generating units are amongst the largest in India. These power houses supply electric energy for electrified tracks, for lighting railway stations, for some of the workshops, for running of electric trains, and even for lighting some of the cities.

ELECTRIC POWER

The first railway electric power station of any magnitude was set up at Jamalpur in 1895. The generating plant consisted of non-condensing reciprocating steam engines driving 220 volts direct current dynamos with a boiler house equipped with single drum hand-fired boilers. Today the Jamalpur power house has an installed capacity of 8,300 kilowatts complete with modern steam turbo-plant equipment. The power house in Kharagpur has a generating capacity of 8,260 kilowatts. By far the largest, most important and most modern is the railway power house at Chola, 30 miles from Bombay having an installed plant capacity of 40,000 kilowatts. After the additional installation, which is now in hand, Chola, will have a capacity of 136,000 kilowatts.

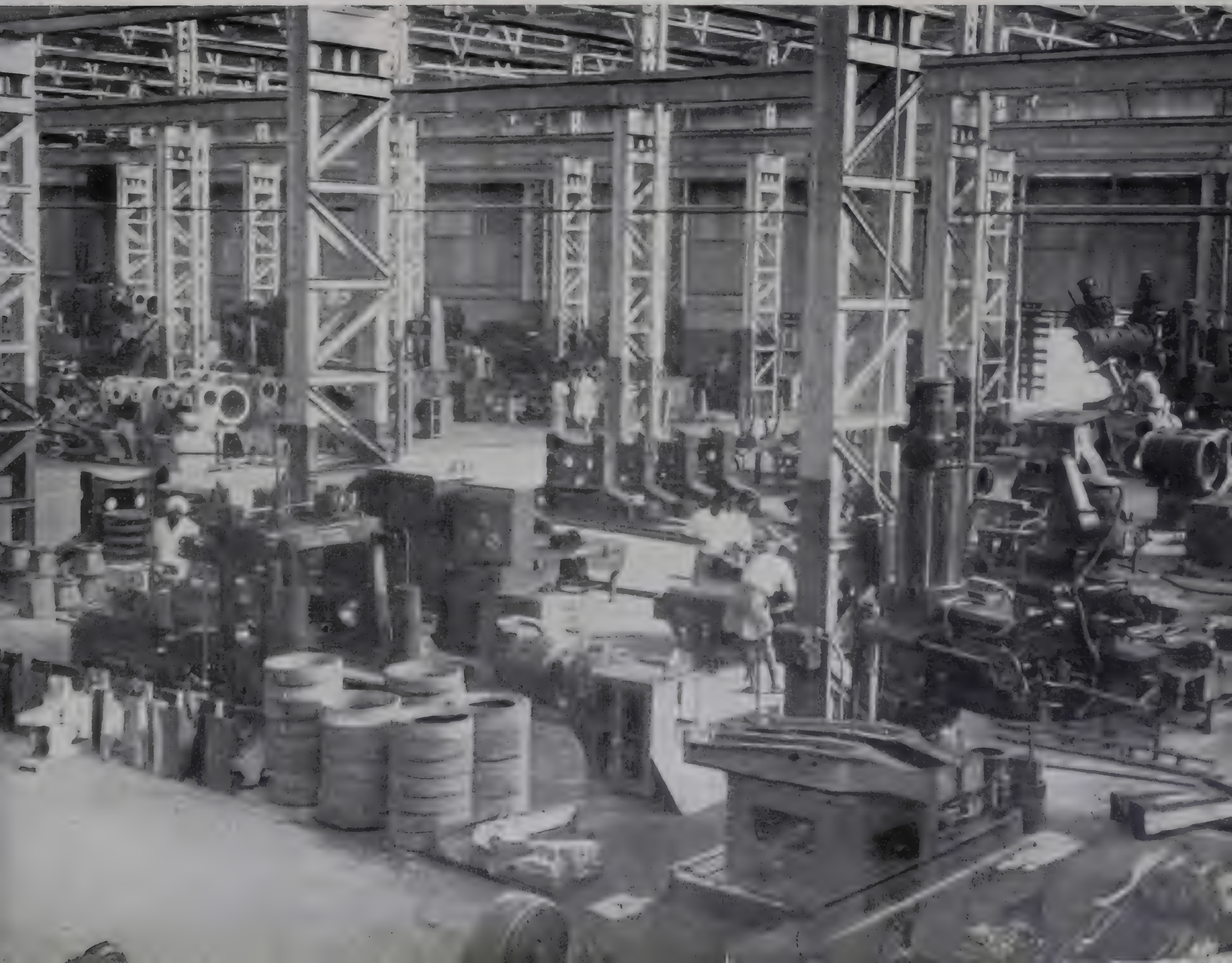
In the realm of minor industrial activity, mention may be made of a large number of printing presses owned and run by the railways in India. Some of these presses, especially those located in the metropolitan areas like Bombay, Calcutta and Madras compare very favourably with large and modern presses in the country.

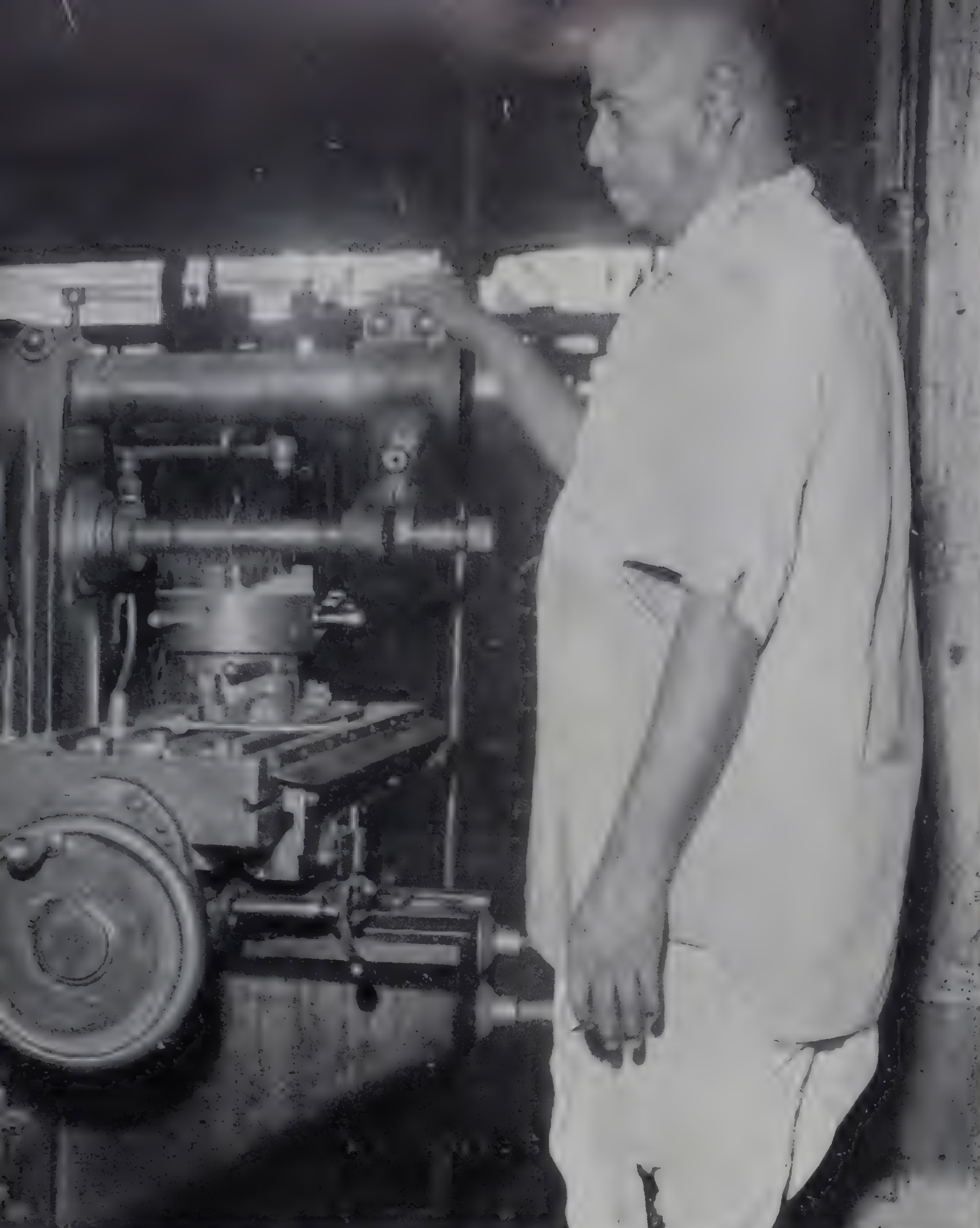
While these are some of the major enterprises directly run and controlled by the railways, there are several industries which have grown up primarily for meeting their various needs. From the steel industry, the railways obtain rails, boilers, axles, tyres, and such small items as bolts, rivets, wire, nails, and hinges. Other industries supply rubber goods, emery cloth, glass paper, grinding wheels, weighing machines, etc. Electric lamps, cables, ceiling fans and a large variety of other electric equipment required for signalling and interlocking apparatus, are obtained locally. Train lighting batteries are also now being manufactured in India for the railways. They also take a bulk of leather and imitation leather cloth, machine tools, paint brushes, linoleum, textiles, etc., manufactured in the country.

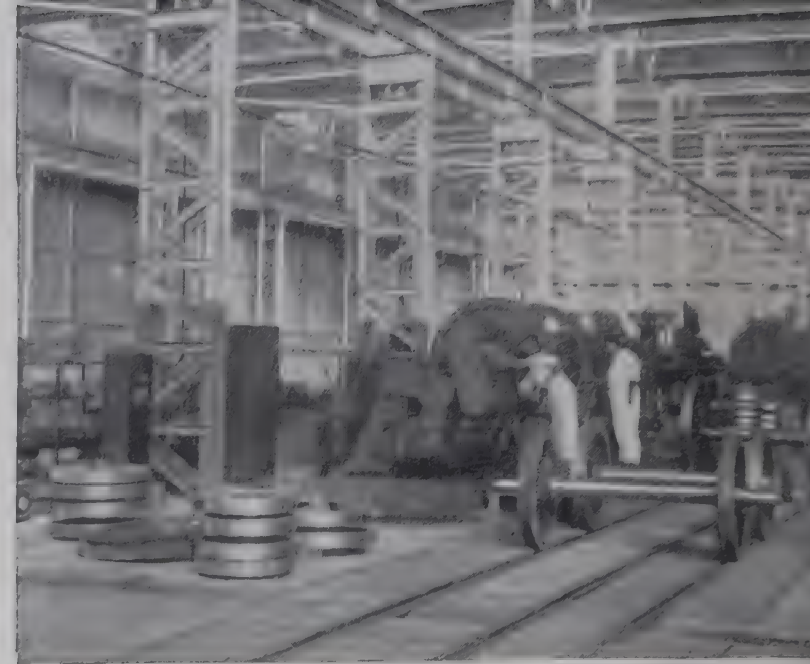
The railways today are, therefore, not only one of the largest industrial enterprises in the world, but have also helped directly to stimulate industrial development in India in many ways, thereby directly contributing in a very large measure to the industrial development of the country.

Above : A panoramic view of Chittaranjan.

Below : A view of the heavy machine shop.



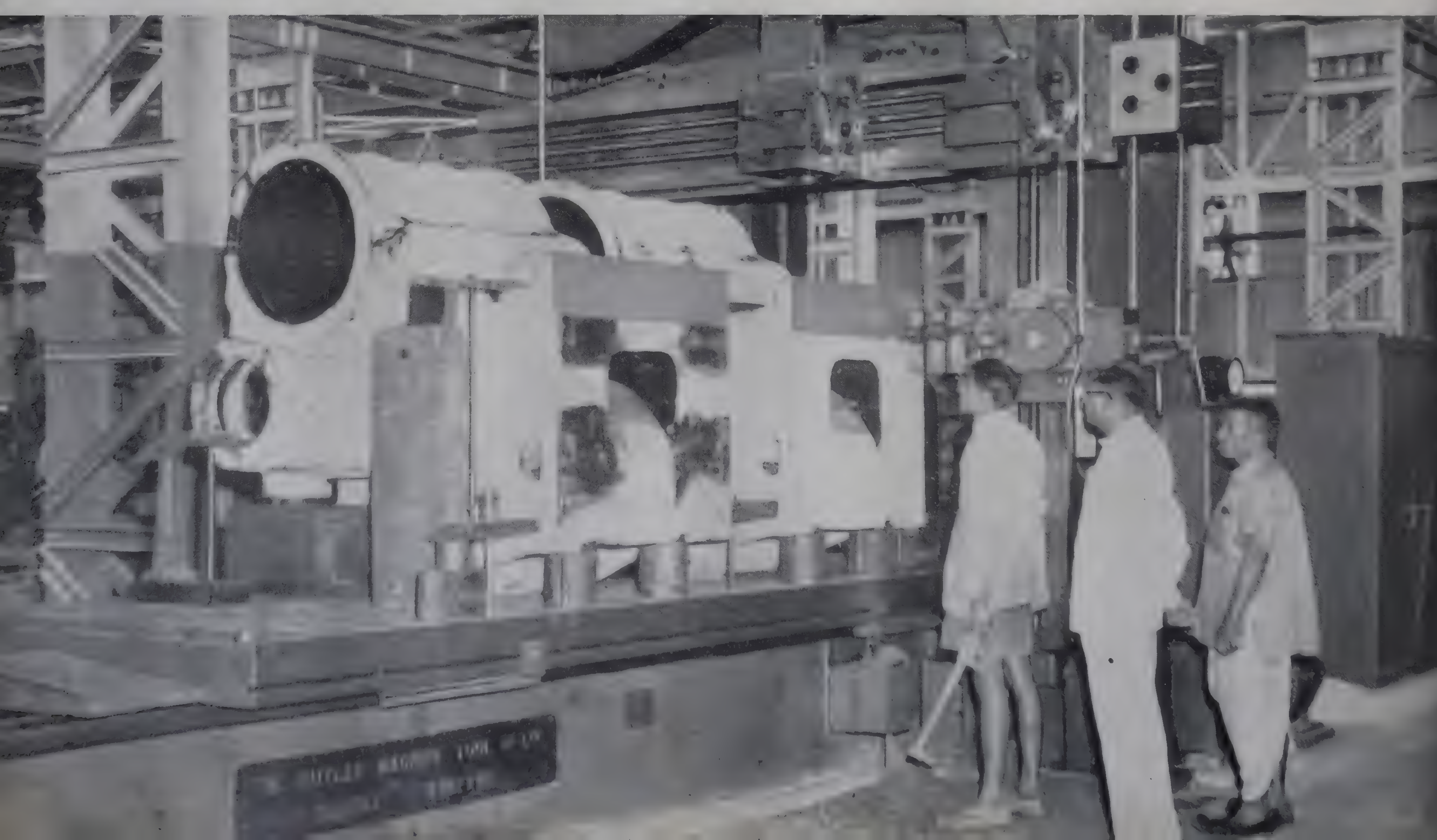




Above : A view of the wheel shop.

Left : A horizontal milling machine in action.

Below : Locomotives cylinders being machined.



XV. Chittaranjan

THE Chittaranjan Locomotive Works and the new city of Chittaranjan, carry the impress of the modern age. They symbolise the spirit of a free and independent India. Both the city and the works are named after one of India's noblest sons—a great and indomitable fighter in the nation's struggle for freedom, a leader and statesman of great foresight and vision—the late Deshabandhu Chittaranjan Das.

Apart from being fully equipped with some of the latest machines, tools and appliances, the factory in layout and design, is one of the most modern industrial units in the country. In terms of actual output, it started in a modest way commencing with three locomotives being steamed during 1950. But the rise has been very rapid, being 16 locomotives in 1951 and 30 locomotives in 1952. The final target is 120 locomotives plus 50 spare boilers per year, which is expected to be reached in the course of the next few years.

As a city, Chittaranjan is an infant, especially in a country where the age of cities is reckoned not in terms of decades but centuries and tens of centuries. Five years ago, the vast expanse on which it is built was mostly jungle or waste land made up of fallow paddy fields. Its small tribal population lived in a cluster of villages some of which even now exist within a few miles of the city. Today Chittaranjan holds promise of becoming, if it is not already, one of the most well-planned, well-designed and neatly constructed industrial towns in India.

THE PROJECT

As projects of any magnitude, the Chittaranjan Locomotive Works and Chittaranjan as a township, were among the first to be taken in hand by the railway administration soon after India became independent. It was in 1947 that the present site was finally selected and plans were drawn up to build the locomotive works, and the new city. During the short space of five years, a clean picturesque modern industrial town, covering an area of over seven square miles of undulating country, and capable of accommodating more than 5,000 families, has been built. The covered area of the works is 8,80,000 square feet, and with the shops and offices over a million square feet. 11,000 tons of fabricated

steel and 1,700,000 cubic feet of cement were used in construction. The Assembly Shop, the largest structure in the whole project, is 1,560 feet long and 212 feet wide rising above the floor level to 75 feet. The Chittaranjan plant is equipped with as many as 985 different machines of the most modern type intended to manufacture more than 80 per cent of the 5,000 odd components required for the construction of a modern locomotive. This is an achievement of which any administration, and any set of engineers can very well be proud.

THE TOWN

Chittaranjan has been built at a cost of approximately Rs 14 crores. The town is built around a formation of undulations. The houses rise tier upon tier in terraces. At night when all the lights are lit the scene is fascinating. Ample supplies of clean water have been made available in every house. Electricity is cheap and abundantly available. Sanitary arrangements, even in the smallest quarter, are up to date. Considering the charges and the type of accommodation made available for the ordinary workers, the standard of amenities at Chittaranjan is as high as perhaps anywhere in the world. A neatly built two-roomed brick house, concrete roofed and concrete floored, having a verandah, a bath-room, a kitchen and an ample compound for a house garden, represents the smallest unit. This is rent-free for certain categories of unskilled workers. The style, pattern and standard of accommodation proportionately vary with the status and emoluments of the employees. The city is designed to prevent segregation of workers of a particular class into special areas, and yet to enable the lowest class of workers to be nearest to the works, the shops centres, and other places of social activity. The main shopping centre is centrally located. Provision has been made for schools, for boys and girls, playing grounds, cinemas, and clubs for the workers. An up-to-date hospital and a few dispensaries are available to the employees and their families. Through the efforts of the Public Health Department, an area which was once infested with the worst kind of malarial mosquitoes, is now practically free from malaria. Because of its salubrious climate it has virtually become a ' health resort.'

THE WORKS

The plant and machinery installed is of the most advanced type, intended for a variety of operations embracing various trades, such as pattern making, foundry work, forge and smithy works, die sinking, drop stamping, heat treatment of steels, welding, tool making, machining of parts to a high precision, boiler making, erection work, etc. In most other countries a number of components that go to build a locomotive are purchased from separate anciliary industries. But in Chittaranjan arrangements have been made to manufacture most of these components in the locomotive works, there being little or no ancillary industry

established in India. The equipment provided is expected to manufacture about 80 per cent of the components. There will be, however, imported for sometime to come, such items as roller bearings, boiler tubes, and some special sections of steel. It is hoped that these will be produced in India to meet full requirements within the next few years.

The shops at Chittaranjan neatly cloaked in asbestos corrugated sheets are located in three groups: south, central and north. The south group consists of the pattern shops and the iron and brass foundries. The central group includes the smithy and forge, and the heavy and light machine units. The north group consists of three bays running parallel east to west with the boiler shop at the north end; the locomotive erecting, the tender and the frame shops in the centre, and the finished parts stores at the south end. This arrangement enables the assembly line in the erecting shop, to be fed with boilers from the boiler shop, and by manufactured components from the machine shop, and the finished parts stores, during the various stages of construction. Starting from the initial stage on the assembly line from the west side, by the time the eastern extremity of the line is reached, the locomotive and tender are complete.

The manufacture of the locomotive components was formally inaugurated on 26th January 1950 by Shrimati Basanti Devi, widow of the late Deshabandhu Chittaranjan Das, and the first locomotive was steamed off the assembly lines by the President of the Indian Republic, Dr. Rajendra Prasad, on 1st November 1950. Since then, up to the end of December 1952, Chittaranjan has turned out 49 locomotives.

THE CHITTARANJAN LOCOMOTIVE

The locomotives at present being manufactured at Chittaranjan are of the 'WG' class intended for hauling goods trains. They have a '2-8-2' wheel arrangement and 18·5 ton axle-load. These locomotives, which are in accordance with specifications drawn up by the Central Standards Office of the Railway Board, have been designed so as to ensure the most economical use of lower grade Indian coals, more efficient generation of steam, and better riding qualities. The WG locomotive is designed to use non-coking coal with a maximum firing rate of 135 lb./sq. ft. of grate area/hour, and developes 38,890 lb. tractive effort. As a result of intensive research carried out in India during the past sixteen years, more economical boilers, a higher degree of superheat and more efficient valve gears have been developed, and all these features are incorporated in these new locomotives.

While Chittaranjan represents a landmark in railway development, locomotive manufacture in India has had a chequered history. Locomotive manufacture first commenced in the East Indian Railway workshop at Jamalpur in 1889. The

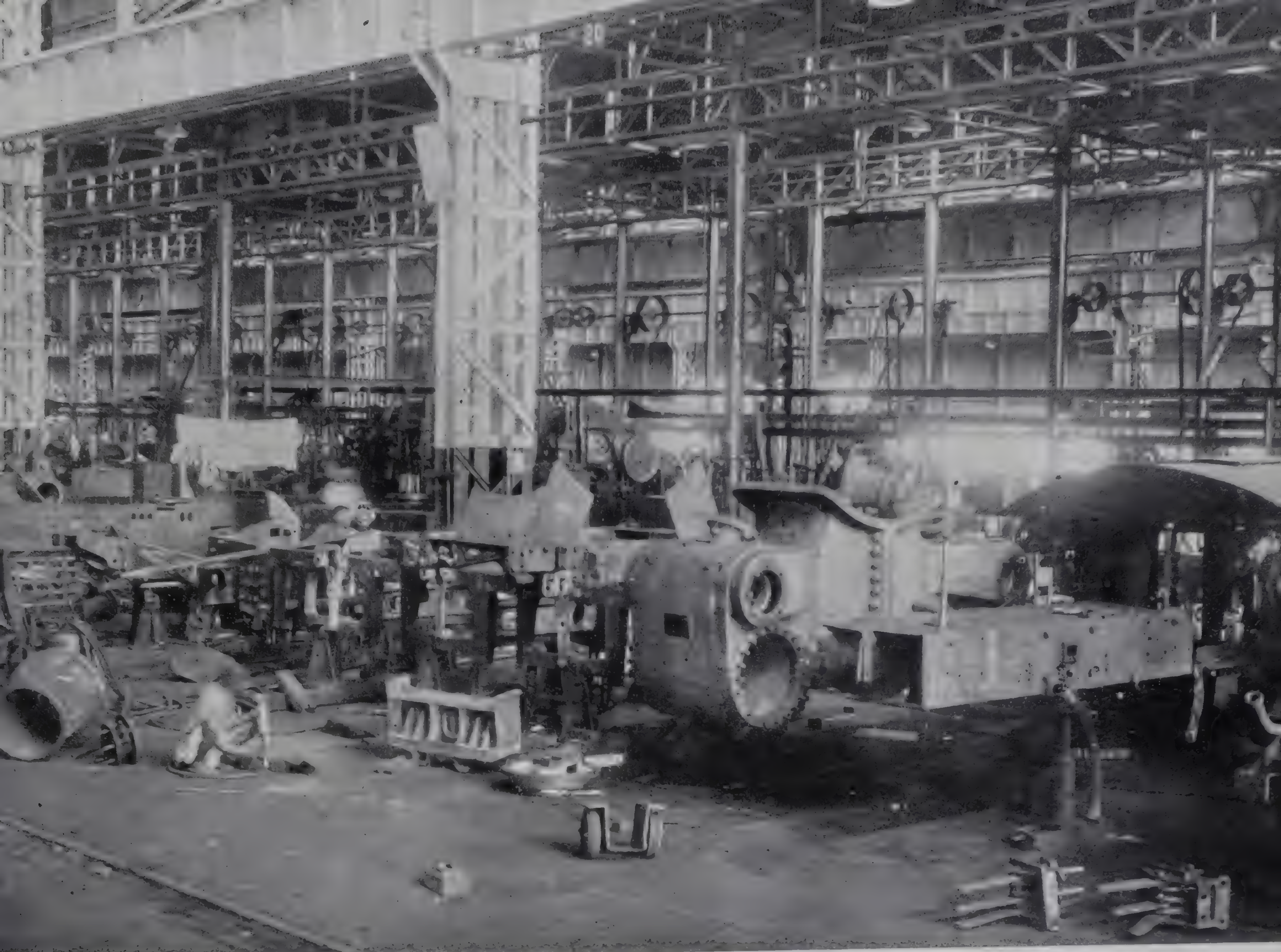
first locomotive for the metre gauge was manufactured at the Bombay, Baroda and Central India Railway workshop at Ajmer in 1896. This seems very creditable, considering that in earlier years, England was the only country to manufacture locomotives, and it was not till 1830 that the first locomotive 'Best Friend of Charleston' could be built even in the United States. It was not till a few years later that locomotives started to be constructed in Germany and France. Even in the nineties of the last century, there were very few workshops outside these countries where locomotive manufacture had been undertaken with mentionable success.

LOCOMOTIVE MANUFACTURE

The first locomotive manufactured in the Jamalpur shops was scrapped in 1932 after being in service for nearly 33 years. The boiler plates, axles and frame plates were the only materials imported from outside. The entire cost of the locomotive was Rs 33,000. During the period 1899-1923 the Jamalpur workshops, besides carrying on their own work of rehabilitation and reconditioning of engines, manufactured 214 broad gauge locomotives of the '0-6-0,' '0-6-4' and '0-6-2' type, and 103 boilers.

The first locomotive to be constructed at the Ajmer workshops in 1896 was a metre gauge '0-6-0' type. It had a six-wheel tender, the engine cylinders were 14×20 inches stroke with a boiler pressure of 140 PSI. It weighed 30¼ tons and was designed for mixed traffic. During the following seven years, nine more locomotives of the same type were constructed. In 1909, a still more ambitious programme was undertaken and five heavier 'P' class passenger locomotives weighing 61·2 tons of the '4-6-0' type with a six-wheel tender were built. Sixty three locomotives of this type were put on the lines up to 1923. The years 1931-38 marked a still greater advance in locomotive engineering. Eighty five IRS locomotives of the 'YD,' 'YB' and 'YF' classes were constructed, incorporating many improvements in design which by that time had become standard for Indian locomotives. The last order for ten tank locomotives of '4-4-4' type was completed in 1950. These locomotives were constructed to design and specifications prepared in India. The Ajmer workshop apart from meeting the requirements of the Bombay, Baroda and Central India Railway, built a number of locomotives for other railways in India, and even for use in Near Eastern countries during the war. These locomotives proved as efficient as any of the foreign types. They were also specially adapted to Indian conditions. They meant considerable economy in initial cost. A study of the comparative figures will show that in 1930 the cost per ton of imported locomotives was Rs 1,170 as against Rs 1,000 of those manufactured at Ajmer.

Manufacture of locomotives at Ajmer was discontinued with the establishment of the Chittaranjan Locomotive Works, Chittaranjan, and the Tata Locomotive



Above : At work on locomotive frames.

Below : Valve gear being put together.

Below : A view of the erecting shop.

Above : Another view of the erecting shop

Right : Prime Minister addresses workers at Chittaranjan during his visit on 1st March 1952.

Below : An engine from Chittaranjan.

and Engineering Co., Ltd., Jamshedpur, as the capacity of the Ajmer workshops is now required for repairs.

Despite these successful attempts, locomotive manufacture on a large scale was not adopted as a part of railway policy. Even when a private enterprise, the Peninsular Locomotive Company, which came into existence soon after World War I, undertook to build locomotives in India at their factory in Singhbum, those in control of railway policy were reluctant to give any encouragement, and the whole plan had to be abandoned. If locomotive manufacture had been seriously encouraged during the earlier years, either by enlisting the support of private enterprise, or by installing the requisite machinery at some of the major railway workshops, India would have become completely self-sufficient in terms of locomotives several years ago, and enormous economies in expenditure would have resulted.

PUBLIC OPINION

It was not unnatural, therefore, that Indian public opinion should have continuously demanded that arrangements be made for the manufacture of locomotives required for India's needs in the country. The agitation became particularly strong after the First World War, when import of new locomotives became difficult and existing locomotives had either completely broken down through wear and tear involved during the war, or were in a dismal state of disrepair. In the Legislative Assembly during the twenties of the present century there was a furore of agitation by Indian leaders of all shades of opinion. No effective steps were, however, taken by the railway authorities to enlarge the scope of locomotive manufacture at Jamalpur and Ajmer. Various practical difficulties were pointed out, and reasons, plausible and otherwise, were advanced in favour of continuing the existing practice of importing locomotives from Britain. The conclusion could not be easily escaped that in this matter, as in many others, those in charge of the railways at the time, were more interested in the welfare and prosperity of British industries, and preferred to extend the patronage of Indian Railways to British locomotive factories, rather than taking steps towards developing this industry in India.

As time passed this agitation became stronger. Finally in July 1939, a committee was appointed consisting of a Mechanical Engineer and Finance Officer, Mr J. Humphrey and Mr K. C. Srinivasan respectively, to examine in detail the scheme of starting the manufacture of locomotives in some of the existing workshops in India, 'and to report on the initial cost and financial implications of such a venture.' The Committee submitted its report in 1940 by which time World War II had started. The Committee, however, recommended that the manufacture of locomotives, despite the war, and even because of it,

should be taken up at once. No steps were taken to implement the recommendations of the Committee. During the war, the shortage of locomotives became more and more apparent. This only served to emphasise the urgency and the imperative necessity for India to become independent and self-sufficient in respect of locomotives and other equipment necessary for railway operation.

It was not till 1945 that any serious consideration was given to the recommendations of the Srinivasan Committee. A provisional site at Chandmari in the then undivided Bengal was selected. Not much progress could be made at this site, because of political changes leading to the partition of India. In 1947, the present site where Chittaranjan is located was finally chosen. The main considerations underlying the choice of the site were, an expansive area of cheap waste land available for building purposes, a natural undulating elevation picturesquely suitable for town planning, a good climate, easy availability of water, proximity to steel and coal producing centres, and to the Maithon Dam and Reservoir of the Damodar Valley Project.

Chittaranjan represents free India's first great step towards self-sufficiency in railway equipment. As a town, it is a model for industrial townships of the future. As a workshop, in layout and design ; and in the type and quality of its equipment, it is illustrative of the desire of modern India to come in line with progressive industrial countries of the world, and to set up standards of efficiency and production comparable with the best.

Chittaranjan is a dream come true!

XVI. Electricity Introduces A Revolution

THE development and the use of electrical power marked the dawn of a new era in the later half of the nineteenth century. Less than seventy years ago, neither the telephone nor electric light were known, to say nothing of wireless or television. The tramways were then mostly horse-drawn, and steam traction was just then establishing a grip on transportation.

With the development of electric power many changes followed. Electricity for lighting and power became a necessity in every home. Electric power began to be used in factories and mills. The telephone became as useful a means of communication as the telegraph.

This new form of power soon invaded the field of transport. Incandescent lamps soon replaced candles, oil lamps and gas lamps on railway stations, in yards and in trains. The electric drive supplanted a number of manual operations and also the mechanical drive in railway workshops. Air-conditioned passenger coaches and refrigerator vans were introduced to transport people in comfort and perishable materials without deterioration. The introduction of automatic colour light signalling augmented safety in railway travel and revolutionised signalling methods. Electric traction revealed its immense superiority and the way to better and faster mass transportation.

EMPLOYING ELECTRIC POWER

The earliest record of electric traction takes us back to 1839, when a small rail locomotive was operated on the line between Edinburgh and Glasgow. It was equipped with a very primitive motor drawing power from a bank of primary cells. Soon it met with an ignominious end at the hands of railway engineers who feared that it might replace the steam locomotive. Nearly forty years elapsed before an electrically propelled vehicle equipped with better motors came into operation. However the first successful use of electric power applied to propelling a vehicle was demonstrated in 1879 when visitors to Berlin Exhibition were transported through the ground in small carriages hauled by electrically operated locomotives.

Though the earlier applications of this form of motive power were successful in some cases, particularly where the characteristics of electric traction showed an advantage, much pioneer work and research had to be done in developing equipment and technique to overcome problems of operation, and in evolving designs of track equipment to reduce initial installation costs.

With the turn of the century, the development of electric traction was rapid. It became popular for handling large volume of heavy suburban traffic which could not be handled by steam traction. Further development led to its adoption in countries having railways with heavy gradients and a large number of tunnels. Electric traction has since made great strides in countries like Japan, Italy, Sweden, Switzerland and France, while in a number of other countries it has been universally adopted for handling heavy suburban traffic.

ELECTRIC TRACTION IN INDIA

So far as India is concerned, electric traction is a comparatively recent development. It has, however, enormous potentialities for the future. The first railway electrification in India was that of the Harbour Branch in Bombay Division of the ex-Great Indian Peninsula Railway from Bombay to Kurla, a distance of nine and half miles, which was opened to electric traffic in 1925 as the first stage in the electrification of the suburban section, Bombay to Kalyan. In 1926, the electrification of the main suburban line from Bombay to Kurla and the extension of electric working from Kurla to Thana and the Mahim chord on the Harbour Branch were opened for electric traffic. In 1929, electrification was completed up to Kalyan, a distance of 33 miles from Bombay.

At about the same time in 1928, the line between Bombay and Borivli, then under the control of the Bombay, Baroda and Central India Railway, was electrified and opened to suburban traffic.

In the years 1929 and 1930, the main line section of the ex-Great Indian Peninsula Railway between Kalyan and Igatpuri on the north-east route, a distance of 52 miles, and between Kalyan and Poona on the south-east route, a distance of 86 miles, were electrified and opened for electric traffic. In 1931, the metre gauge track between Madras Beach to Tambaram was electrified and commissioned for suburban traffic. In 1936, the section between Borivli and Virar on the ex-Bombay, Baroda and Central India Railway was equipped for electric traffic.

There has since been no further development of electric traction in India though a number of electrification schemes are under scrutiny. A scheme to electrify the suburban lines in the vicinity of Calcutta is under active consideration, while electrification of the section between Igatpuri and Bhusaval on the Central Railway is also receiving serious consideration.

ELECTRIFICATION ON THE CENTRAL RAILWAY

The electrification of track in Bombay was seriously considered as early as 1914. No active steps could, however, be taken on account of the war. In 1922, approval was given for the scheme of electrification of the suburban section between Bombay and Kalyan. An incentive was offered to this scheme by the housing problem which had become acute in Bombay following the war. This necessitated steps to be taken for the development of the suburbs of Bombay to spread the population.

SUBURBAN TRAFFIC

As a first step, the Bombay Municipality developed a scheme to house industrial workers along what is now known as the Harbour Branch. This fact is of technical interest since it was an important determining factor in favour of electric traction. The only practicable manner in which this connection could be effected was by taking the track on a series of masonry arches and steel viaducts for a distance long enough to enable it to cross the Wadi Bunder goods yard and the quadruple track of the main line entering the Bombay Terminus. This necessitated a short stretch of gradient of 1 in 34 on a heavy curve where the harbour branch line descended to the level of the main line. It was felt that an intensive suburban service could not obviously be operated by steam traction on such a gradient. This was one of the important reasons which determined the decision to electrify the entire suburban track up to Kalyan.

In the initial years following the electrification of the suburban lines, the expansion of traffic was less than what was anticipated owing to the general trade depression and the slump experienced in the early thirties. But very rapid development has taken place during the last ten years. Today the suburban electric services are extremely popular and have proved a blessing to the people of Bombay.

The train services afford a cheap means of transport and have been mostly instrumental in the development of the suburbs. Since the electrification of the suburban lines, the population of Bombay has increased from half a million to nearly three millions in 1950-51, and some of the suburban townships around Bombay have sprung only after electric trains had began to run. In the years 1926-27 the Railway carried only 32 million passengers, but in the year 1951-52 the number of passengers carried increased to nearly 292 millions. Today on the Central Railway alone more than 550 suburban trains are run daily on the suburban section.

GHAT BOTTLE-NECKS

The reason for electrification of the main line upto Igatpuri on the north-east and Poona on the south-east routes were, however, different. While it had been

possible to lay the lines over the Thal and Bhore Ghats inclines, the Ghats sections were a serious bottle-neck for the expeditious movement of trains. The steam traction was also proving uneconomical. Passenger trains had to be worked by special ghat engines and goods trains had to be broken up into two parts before they could be transported over the Ghats, having a ruling gradient of 1 in 37.

There was also considerable passenger traffic between Bombay and Poona, which was a week-end attraction for race fans and an attractive health resort, at all times of the year. It was felt that an improved passenger service would result not only in a further increase in traffic and earnings but also in the development of various stations lying on the route between the two cities. This provided another reason for electrification of the track between Bombay and Poona.

Electrification of these sections of the main line has helped considerably to remove the bottle-necks on the Ghats and has simplified the operation of train services. The running time of mail and express trains has been cut down by more than an hour. Through trains like the 'Deccan Queen' are now able to make the journey from Bombay to Poona in three hours. It has been possible to increase the leads of goods trains, and to carry them over the Ghats without breaking up, resulting in considerable operational savings and higher scheduled speeds.

The track, broad gauge all through, has been equipped for 1,500 volts direct current electric traction. There are in all 16 sub-stations having a total installed plant capacity of 103,000 KW. Of these, eleven sub-stations are controlled from a central supervisory central room located at Kalyan.

ELECTRIC POWER

The electric power for working all electric trains is generated at the railway's Kalyan Power Station which was commissioned with an initial plant capacity of 40,000 KW in 1929. In order to meet the entire requirements of energy of both Central and Western Railways, the installed capacity of this power station is being augmented to 82,000 KW. The first stage of additions to the plant was recently completed when one 12,000 KW. set was commissioned in December 1952.

The rolling-stock for working electric trains in the Central Railway consists of 67 four-car electric multiple-units, 25 passenger and 41 freight locomotives. Of the multiple-units 16 four-coach units were introduced into service in the year 1951. The design of these new coaches is a radical departure from the old ones. Light weight construction has been adopted. For the first time in the history of Indian Railways, electro-pneumatic compressed air braking and flourescent lights have been employed on this electric stock.

The electrification of the suburban section of the Western Railway between Bombay and Borivli, a distance of 22½ miles, was completed late in 1928 and, as mentioned before, an extension to this line was opened from Borivli to Virar, a

distance of 16½ miles, in the year 1936. The reason for electrification of the suburban section was to provide quicker means of transport for the increasing suburban population. As in the case of the ex-Great Indian Peninsula Railway, the traffic increase during the initial years following electrification was not as great as it was anticipated owing to the world depression, but the traffic has increased enormously in recent years and the number of suburban passengers carried rose from 31 millions in 1930-31 to more than 150 millions in 1950-51.

The track is equipped for 1,500 volts direct current electric traction. There are in all five sub-stations and one more is under erection. The rolling-stock comprises of 52 four-car units of which twelve are of modern design commissioned early in 1952.

SOUTHERN RAILWAY

New tracks were built between Madras Beach and Tambaram, a distance of 18 miles, to introduce electric suburban train service. The line was opened for electric traffic in 1930. The track, metre gauge all through, is also equipped for 1,500 volts direct current electric traction. As in the case of Bombay, the line was electrified in order to provide a better and faster mode of transportation for the suburban population. The passenger traffic increased steadily after electrification as was the case with the Bombay Railways.

The rolling-stock comprises of 17 three-car articulated framed units, and the power supply for the electric trains is drawn from Madras Electric Supply Co., through two traction sub-stations installed for the purpose.

XVII. Hill Railways

'If there is paradise on earth, It is *Here*! It is *Here*! It is *Here*!' remarked the Moghul Emperor Jehangir as he set eyes on the picturesque landscape of the Valley of Kashmir. Kashmir is heavenly! But between Shillong and Srinagar—a stretch of more than 1,400 miles of mountainous terrain, nestling in the snowy peaks of the mighty Himalayas, or down south in the Nilgiris Hills, lie hundreds of other beauty spots as picturesque as any in the world. It is here that mother nature casts a spell on the visitor as fascinating to the eyes as it is edifying to the soul.

NATURE AT ITS BEST

Through thousands of years of India's hoary history, these spots have attracted saints and savants in search of peace and solitude, explorers hungry for knowledge of the secrets of nature, pilgrims seeking divine inspiration, tourists wanting to feed their eyes on the glories of God's creation, and mere men seeking relief from the summer heat of the plains. Mighty glaciers, a vast unending panorama of snow-covered peaks, waterfalls breaking through the sides of lofty mountains to join their waters with torrents, rivers and lakes, giant rocks protruding baldly out of green foliage, countless varieties of wild flowers lending a motley touch to the landscape, lofty conical trees shooting skywards, all combine to lend picturesqueness to the scene. The construction and operation of hill railways have involved some difficult feats of engineering and great ingenuity and resourcefulness on the part of the builders.

Before the advent of railways, most of the hill spots could be reached only on foot, on horse-back, by palkis and dolis carried by hill porters, by horse carriages, or by bullock carts.

During the early days of the East India Company, Simla, Solan, Dharampore, Nainital, Darjeeling, Kurseong, and in the south, Ootacamund, Coonoor and Kodaikanal had grown into small European settlements. The 58 miles of road from Kalka to Simla was built in 1856 by Colonel Kennedy, then Military Secretary to the Commander-in-Chief. To Lord Napier of Magdala, then Lieutenant Napier

Use of loops and reverses have helped to eliminate the need for tunnels on the Darjeeling Hill Railway.

Above : The Batasia Loop at Ghoom.

Below : The Blue Mountain Express, passing through one of the tunnels. The picture shows the difficult terrain typical of the route between Mettupalaiyam and Ootacamund.

The Nilgiri Mountain Railway extending from Mettupalaiyam Ootacamund, "the Queen of hill stations" has several unique features of construction some of which are illustrated in the photographs reproduced on this page and on pages facing 120 and 121.

Above left : A bridge leading into a tunnel.

Above right : The engine getting into a position over the three rails. Observe the rack line in the middle.

Left : Train bound for Ooty over one of the many viaducts.

Below : A near view of the permanent way over the bridge showing the rack line.

of the Indian Army, goes the credit for having built in 1861 the road from Siliguri to Darjeeling.

The first experiment for constructing a hill railway was carried out in Switzerland. To the people of Switzerland and of other countries along the Alpine range, the Alps presented a serious stumbling block. As early as 1839, M. Lanicca advanced the daring idea of going across the Alps by rail, carrying the line through the Splugen Pass at a height of 7,000 feet. Lanicca was just ahead of his times. The honour of blazing the trail of the first railway train across the Alps goes to Chega, an Austrian, who built the Semmering line over the eastern Alps. It was the first mountain railway in the world, and has in many respects been the model for later projects. Chega was the first to apply the principle of artificially lengthening the line by looping in order to flatten the gradient. In 1878, this principle was successfully applied by engineers of Indian Railways in constructing the line from Siliguri to Darjeeling, thereby completely obviating the necessity of expensive tunnels. Another method adopted on the route to Darjeeling is reversing or zig-zag movement, each leg of this move being utilised to gain additional height, although this means the train moving backward on the central leg.

FIRST EXPERIMENTS

Another device, which has been successfully employed on mountain railways, is based on the idea of a central rail which was adopted as early as 1812 by Blenkinsop in his first engine operated on a horizontal track. J. B. Fell, an Englishman, constructed the first hill locomotive which relied on a third rail for negotiating steep and sharp inclines. The engine had two horizontal wheels pressed against the rails by powerful springs. This enabled the locomotive to get a grip on the auxiliary rail and pull itself upwards even on very sharp inclines, the wheels, of course, being driven by the locomotive. Fell built an experimental track and showed that his locomotive could take a gradient of 1 in 10 with remarkable ease. His locomotive had other advantages. It was light and cheap, and with its firm hold on the third rail it was to all intents and purposes proof against derailment. Fell's locomotive has served as a model for some of the later locomotives employed on hill railways.

DARJEELING RAILWAY

Considering the difficulties which confronted railway engineers during their early attempts to cross the Alps, the construction of the railway line between Siliguri and Darjeeling in 1878 must appear an undoubtedly remarkable achievement. To Franklin Prestage, the then Agent of the Eastern Bengal Railway Company, goes the credit for preparing the scheme and for completing the

construction in two years. The line consists of 51 miles of a two-foot track. It follows mainly the route of the original cart road. Zig-zagging over deep ravines and precipices, taking sharp curves and rising over steep inclines, it reaches a height of 7,000 feet in forty miles. The ruling gradient is 1 in 25, although in places the gradient is 1 in 20 and in one place actually 1 in 19. The sharpest curve has a radius of 59 feet. The need for tunnels was completely obviated by means of ' loops ' and ' reverses '. In the ' loop ' the railway track circles around and passes over a gradient by a bridge thereby quickly attaining a higher elevation. In the ' reverse ' the same object is obtained by running the track back diagonally and upwards for a short distance, and then using an alignment parallel to the original alignment but higher up the side of the mountain.

The engine originally employed was very small even for a two-foot track and was only capable of drawing a load of about seven tons. The standard type now in use can draw a load of 32 tons. These engines have four wheels with cylinders of 11 inches bore and 14 inches stroke. They weigh 14 tons. Two rectangular boxes are fitted in the front of the locomotive for carrying sand, which is sprinkled by attendants on the track, to ensure a firmer grip of rails during the monsoon. The locomotive carries the coal tender on top of the boiler. Ornamentally painted in green, the locomotive looks almost like a giant war horse straining to draw a heavy chariot as it pants and throbs, struggling to pull its loads up sharp inclines. The original passenger vehicle was a small four-wheel trolley with a canvas roof and two wooden benches for seats. Carriages 26 feet long and 6 feet 9 inches wide and comfortably fitted are now in use. Bogie vans and trucks, the longest being 32 feet, are used for freight.

DARJEELING

The railway passes through different climatic zones representing striking differences of foliage, and offering a variety of scenic effect not to be seen in any part of the world. In the lower forests the traveller will see stalwart sal trees, rising out of an endless landscape of tea gardens and paddy fields. As the track twists out of ravines and ascends the mountains, one sees gigantic fir trees, the buttressed semul, palms, and the giant bamboo all entwined with creepers and loaded with numberless ferns and mosses. On reaching an altitude of 3,000 feet, the forest and the mountain sides are filled with fig trees, the screw pine, oaks and chestnuts. Higher still at 4,000 feet, one comes across the birch, the maple, the tree ferns, while numerous lichens, orchids and mosses, carpet the hillside and hang from the branches of the trees. At still higher elevations, tall oaks and chestnuts grow interspersed with walnut trees. Virtually in the wild and growing in great profusion are to be seen magnolias, wild hydrangeas and rhododendrons. Nowhere else can be seen in one journey of a few hours such a combination of luxurious vegetation,

primeval forest, and sublime mountain peaks, as between Siliguri and Darjeeling. At Darjeeling itself a spectacular landscape of snowy heights unparalleled in the world lies open to view, more than twelve peaks rising above 20,000 feet, some of them still unexplored.

The idea of a railway to Simla was mooted as early as 1847. In the *Delhi Gazette*, a correspondent in November 1847, sketched the route of the railway line to Simla with detailed estimates of cost and traffic returns. He wrote: 'We may then see these cooler regions become the permanent seat of a Government, daily invigorated by a temperature adapted to refresh a European constitution, and keep the mental power in a state of health, alike beneficial both to rulers and the ruled.'

SIMLA RAILWAY

It was not, however, till 1903 that the railway could be built. The sixty miles of narrow gauge track between Kalka and Simla runs through picturesque mountainous country ascending from 2,800 feet, the elevation of Kalka, to 7,000 feet. During its course the line runs into a continuous succession of reverse curves of 120 feet radii in and out, along the valley and the spurs flanking the mountain. The track rises in sharp curves to steeper gradients. Some of the works involving engineering skill of the first magnitude had to be undertaken. Besides innumerable cuttings and embankments, the route runs through as many as 103 tunnels totalling five miles in length. The longest tunnel is 3,752 feet at an altitude of 5,000 feet. The numerous picturesque arch viaducts over which the track runs aggregate one and three quarter miles.

The Nilgiri Mountain Railway commences from Mettupalayam, the terminus of the broad gauge system of the Southern Railway, and runs to an altitude of 7,500 feet to Ootacamund, one of the prettiest summer resorts in South India. The scheme for the construction of a railway from Mettupalayam to Coonoor, a distance of 16·75 miles, dates as far back as 1854, but it was not until 1891 that the work of construction was started by the original Nilgiri Railway Company. The first sod was turned by Lord Wenlock, the then Governor of Madras. In 1894, the Nilgiri Railway Company went into liquidation and a new company was formed in 1896. The line was finally opened in June 1899. On 1st January 1903, the Government purchased the new company and work was taken in hand to construct the 11·75 miles to Ootacamund. The line was completed in October 1908.

OOTACAMUND

Ootacamund is situated in the heart of the blue Nilgiri mountains. Unlike Darjeeling and Simla it lies on a plateau giving the appearance of a vast park.

To the north-west of 'Ooty' are picturesque downs, which remind European visitors of the countryside of Sussex, in Britain. To the west, south and south-west rise ranges of lofty hills adding to the grandeur of the scenery.

From Mettupalayam to Kallar, the first station, a distance of about four and three quarter miles, the line runs for the most part skirting the several hills on a steep ascent, the steepest gradient being 1 in 40. Beyond Kallar, the line takes a serpentine course through sloping hills necessitating sharp bends, which have, in many cases, a curvature of 17½ degrees. The steepest gradient between Kallar and Coonoor, a distance of twelve miles is 1 in 12·5, and between Coonoor and Ootacamund, a distance of 11·75 miles, the gradient is slightly flatter, the steepest bits being 1 in 23·81. Over the 28½ miles between Mettupalayam and Ootacamund, there are 16 tunnels totalling 3,090 feet in length, 14 of these lying between Kallar and Coonoor. The line passes over many girder bridges, some of them with spans as long as 100 feet, constructed over deep precipitous ravines. The deepest of these ravines has its bed at about 81½ feet below the rail level. A large number of the bridges are situated at entrances to tunnels and on sharp curves, involving great engineering skill.

SPECIAL DEVICES

Owing to the extraordinarily steep character of the line between Kallar and Coonoor, rack bars on special chairs, have had to be provided at several places centrally between the track rails. These rack bars are laid on the slope of the line itself and form a sort of ladder up which the engine climbs and pushes the train. These racks are laid in a double row about one and three quarter inches apart and two and a half inches above the running rail so that the tooth of one is directly opposite the gap of the other to ensure that the engine pinions do not work off the rack when negotiating curves. The teeth of the rack are spaced 4·72 inches centre to centre, and correspond to the pitch of the cogs of the driving wheel fitted to the locomotives. Special rack entries are provided for enabling the engine to enter the rack portion smoothly and to ensure proper meshing of the cogwheels of the engine with the rack bars.

The locomotives are tank engines of the four cylinder compound type: the high pressure cylinders working the adhesion engine and the low pressure cylinders superimposed to work the rack engine. Steam acts through a separate set of cylinders and drives a special crankshaft connected by spur gearing with the axle carrying the toothed wheel. A mechanical device has been fitted to the engine whereby oil is forced by steam through a pipe on the pinions and thereby to the rack bars. This oiling is very essential to prevent undue wear on the rack bars which are subjected to heavy strain when engines are ascending.

Trains are pushed up and hauled down the track, thus obviating the danger of vehicles escaping by parting, as a result of couplings giving way. In view of

Above : The Blue Mountain Express, on the Niligiri Mountain Railway. Observe the guard on the look out for any obstruction, while the train is being pushed by the engine from behind.

Below and right : Land slips causing accumulation of boulders on the track as shown in these two pictures are frequent on this line, and the train staff have to keep a sharp look-out for such obstructions which might meet them suddenly on coming round a sharp curve.

Above : An example of the loop system on the Darjeeling Hill Railway.

Right : A view of a passenger train on the Nilgiri Railway ascending on a deep gradient of 1 in 12.

Below : A view of the hill section between Bidarpur and Lumding on the North Eastern Railway. Observe the stretch of goods wagons beyond the short tunnel.

the steep gradients the locomotives are provided with four independent brakes for controlling them. They are the hand and vacuum brakes for adhesion, the hand brake for the rack, and the air compression brake. The hand and the vacuum brakes on these locomotives are similar to the hand and vacuum brakes on the other conventional locomotives. The hand brake operates on the rack wheel much in the same way as the brakes of a motor car. The air compression brakes are for use on descending trains. On such trains the engine is in front but with chimney trailing. But the engine is kept in forward gear and air is allowed into the cylinders and compressed by the pistons. The engine works in the opposite sense as when working with steam, that is, as a compressor. The braking effect of the air compression brake is controlled by two receiver valves 'law pressure' and 'high pressure.' By shutting these valves gradually, the braking effect is brought to a maximum, and by opening these valves, the braking effect is reduced to a minimum. Besides, all coaching and goods vehicles are provided with separate brakes, both for the rack and adhesion. A vacuum brake lever is provided on each vehicle and for operating these in emergencies a brakesman travels on each vehicle. The speed of the train is generally maintained between eight and nine miles an hour on steep gradients of the track, and 20 miles an hour on comparatively easier sections.

MATHERAN LIGHT RAILWAY

At a distance of only about 60 miles from Bombay lies Matheran, a favourite hot weather resort of Bombayites. 'Matheran' means 'forest on the top.' Matheran is situated at an average height of 2,500 feet above sea level, and was discovered in May 1850 by Mr Hugh Poyntz Malet, the Collector of Thana. The visit to this station in 1855 by Lord Elphinstone, the then Governor of Bombay, laid the foundations of the future development of Matheran as a hill station.

This narrow gauge hill railway, connecting Neral, a station on the south-east section of the Central Railway main line, to Matheran was opened to traffic in 1907. It was built by Sir Adamjee Peerbhoy, who formed a limited company with an authorised capital of Rupees ten lakhs only, divided into 2,000 shares.

The railway itself is 12·6 miles long and has a gauge of only two feet. The permanent way consists of 30-lb rails with a ruling gradient of 1 in 20. The track zig-zags up the side of the hill, bringing into view the full beauty of the Matheran Hill. In its tortuous ascent of this precipitous mountainous escarpment, considerable engineering skill is evidenced. The maximum permissible speed is twelve miles per hour on straight track but on the sharpest curve which has a radius of only 60 feet the speed is restricted to only five miles per hour.

The rolling-stock consists of four locomotives of '0-6-0' type capable of hauling a gross load of 36 tons. The alignment closely follows the contours of the Matheran Hill and the line itself is a good example of a mountain railway constructed in an economical manner.

XVIII. Employees

RAILWAYS are the largest employers in the country. Indian Railways today, have 925,000 persons on their pay roll. One among every 400 Indians is a 'Railway Man.' One in every 100 families looks to the railways for support. The railway bill for employees during 1951-52 was Rs 122 crores being about half of the annual working expenses. Besides the men directly employed, a very large number serve in ancillary industries, or on constructional works associated with railways.

> 'The problems affecting railway labour in India,' wrote the Royal Commission on Labour in 1931, 'are as varied as they are numerous. There are several factors peculiar to each railway which have an important bearing on the conditions of labour pertaining to that particular line. Among these are the length of the railway, the territories through which it passes, the climate, ethnological and other features peculiar to these territories, and industrial progress made by the people living therein, the scope such progress affords for the satisfactory recruitment of railway labour, and the other avenues of employment open to labour.'

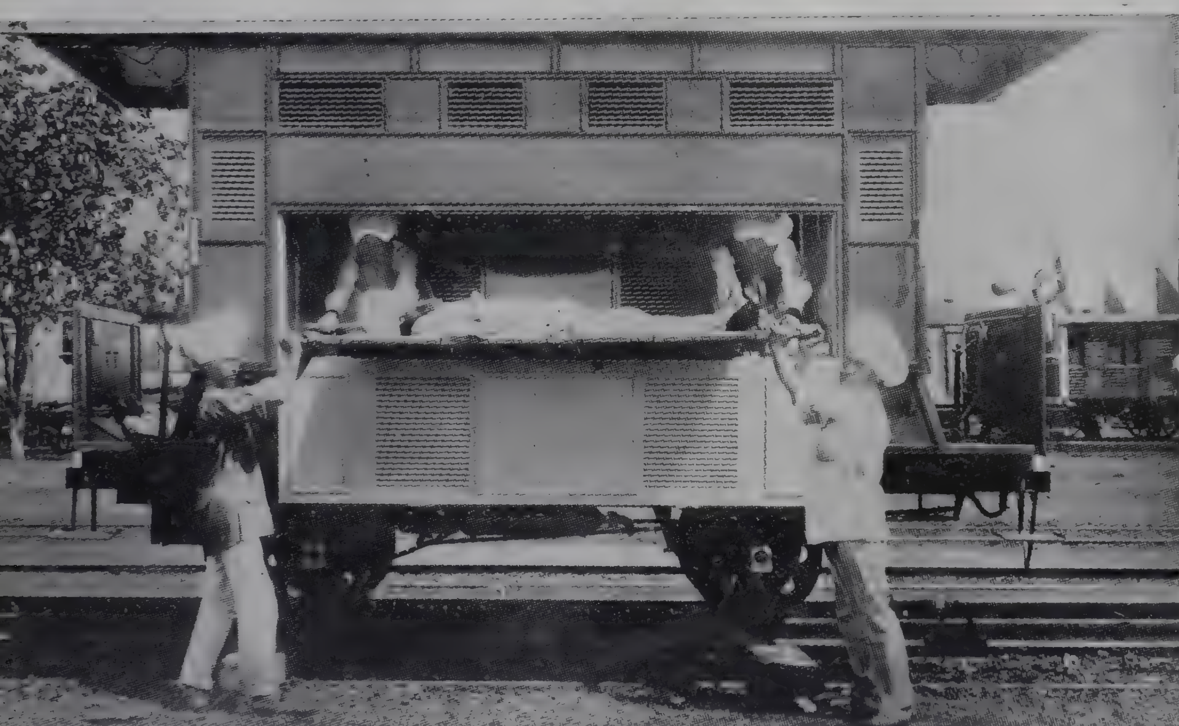
More than 600,000 railway employees belong to what is generally known as the working class. These consist of porters, gangmen, pointsmen, cleaners, sweepers, watermen, workshop employees, labour employed in mines, locomotive sheds, train examining depots, ferries, and on the maintenance of the permanent way. It cannot be said of the railway companies that the wages offered by them were substantially higher than those available to workers in other trades and industries, or that the conditions of work were very much better. During the first fifty years according to the Labour Commission, 'it was more or less a case of bargaining for the most favourable terms on both sides.' The only notable amenity during this period was the institution in 1880 of a Provident Fund.

IMPACT OF WAR

It was not till World War I that the railways began to give serious thought to the general welfare of low paid employees. During the war a substantial increase in wages and allowances became necessary and even cheap grain shops were opened to mitigate the effects of rising prices and the mounting index of living. After

Above : A type of staff quarters.

Below : Staff quarters of the Perambur Workshop, Madras



A great deal of attention is paid to medical welfare and aid to railway employees on all railway systems in India.

Above : A general ward in a railway hospital.

Left : A patient is being transferred on a stretcher to a motor ambulance.

Below left : A surgeon working in an operation theatre.

Below right : Men engaged in malarial research in laboratory at Garden Reach, Calcutta.

World War I the labour situation became acute. Prices continued to rise. There was general demand not only for making permanent the increases which had been sanctioned under the duress of emergency, but also for further substantial enhancement of wages and salaries. The impact of war had also made labour conscious of its rights. For the first time railway workers started unions and began to assert themselves collectively for a better deal.

Before World War I strikes were rare and unusual, and were mostly confined to particular localities, or to a small number of workers. During the years immediately following World War I, labour unions began to grow and multiply and became powerful instruments for collective bargaining. In 1924, the All India Railwaymen's Federation had on its affiliated list more than a dozen railway unions comprising a membership of over 200,000. During this period strikes became common, indicating a general state of distress and dissatisfaction on the part of the railway workers.

COLLECTIVE BARGAINING

During 1921-22 alone, there were 48 strikes on various railways, lasting from a day or two, to three months. 'In the whole history of the East Indian Railway', writes Huddleston, 'there was never a more unhappy period than that which started in the early days of December 1921, and continued until the beginning of April 1922. Four solid months of misery for the staff and of anxiety for their employers.' Describing some of the most serious among these strikes, Huddleston writes: 'On 3rd December 1921, 7,000 of the workmen at Lillooah Carriage and Wagon Shops, practically the whole staff, went on strike. On the last day of February, serious rioting occurred at Howrah station, a few miles from Lillooah. It was said to have been caused by the Lillooah men who believed that a general strike was imminent that day. . . . Compared to the previous year there was a drop (in earnings) of about Rs 75½ lakhs. In addition, claims for loss and damage to goods in transit amounted to more than 21 lakhs.' These strikes naturally roused a great deal of public sympathy for the workers, inside and outside the legislature.

Progressive improvements in the conditions of labour and the amenities granted to them were made. Hours of work were fixed by statute and payment of overtime was made compulsory. The right of workers to form trade unions and to resort to collective bargaining was recognised. Membership to the Provident Fund was extended to more categories of workers. The benefits of sick leave were made available to the inferior staff. Conditions in workshops underwent considerable improvement. A large number of co-operative societies were started to encourage thrift among labourers. More funds were made available for improving housing conditions and the general standard of life in workers' colonies.

Since 1947, conditions of railway workers have further improved. The Government of India then appointed an Adjudicator, Justice Rajadhyaksha, and the Central Pay Commission presided over by Justice Varadachari; the former to consider the hours of work, periodic rest, etc., of railway workers and the latter to go into the whole question of emoluments of Government employees. They made valuable recommendations which since have to a considerable extent been implemented.

AFTER INDEPENDENCE

Prior to the appointment of the Pay Commission, there were hundreds of scales of pay for employees on Indian Railways. The scales of pay for identical or similar jobs also varied widely in various parts of the country. The Commission standardised the scales, and reduced the number to less than 30, rating each according to qualifications, degree of skill required, and nature and value of work. It recommended a compensatory and house rent allowance at specified stations and removed several existing anomalies. As a result of increases in wages and salaries recommended by the Pay Commission, and later the Joint Advisory Committee for Railways, the railway paybill for employees naturally registered a steep rise. Between 1946-51, it had almost doubled without any substantial increase in the number of employees. Leave rules were also considerably liberalised and even temporary employees after one year's service are now treated *at par* with permanent staff in the matter of earning and taking leave and leave-salary. Hours of work for staff classed as continuous workers were reduced from 60 to 54, and for intermittent workers from 84 to 75 per week, and overtime allowances increased from 1¼ times to 1½ times the normal rate of pay. Grant of periodic rest was also liberalised. Running staff who were not hitherto governed by Hours of Employment Rules were henceforward expected to work for 54 hours and were entitled to the benefit of overtime allowances.

In the higher services, for reasons to be explained, there has been a scaling down of salaries and allowances, rather than a scaling up. An important change in respect of superior staff during this period, however, has been overall Indianisation of the upper cadres of service.

SUPERIOR STAFF

The manner in which the superior staff was divided in terms of European and Indian personnel in earlier years is appropriately summed up in the following words of the Acworth Committee (1920-21):

> 'At the date of the last report there were employed on the railways of India about 710,000 persons. Of these, roughly 700,000 were Indians and only 7,000 Europeans, a proportion of just one per cent. But the 7,000 were like a thin film of oil on the top of a glass of water, resting upon but hardly mixing with the 700,000 below.

Community life in a railway colony calls for many-sided activities.

Above : A maternity class at Jamalpur Health Centre.

Right : Women are seen attending adult literary class.

Below : A picture taken at a baby show.

Special interest is taken in railway colonies in children's welfare for the purpose of building up the health of children.

Above : Children undergoing general health check-up at one of the centres.

Right : A toddler tipping scales, and weight is being carefully noted.

Above : Children being given BCG vaccination.

Below : Milk being distributed to children in a welfare clinic.

Railway sports and athletics are encouraged among railway employees and their children and various facilities are provided for the purpose.

Above : Railway athletes at the Inter-Divisional Athletic Meet at Kanchrapara (1951), Eastern Railway, displaying Divisional colours.

Below left : A railway athlete taking a high jump at the Annual Divisional Sports at Howrah.

Below right : A large crowd of railway workers watching a football game between two railway teams.

Below : Girl students parade

Below : School children at physical training at Anglo-Indian Railway School, Guntakal.

Indian Railways maintain schools where the educational needs of the children of railway employees are looked after.

Above left : Students at a fine arts class in a railway school.

Above right : Girl students taking the first-aid class.

Right : Boys and girls taking lessons in gardening at the Indian Railway School, Guntakal, Southern Railway.

Above : Boy students at drill in a Railway school.

Right : Boys' spinning class at the Middle School, Jamalpur.

Below left : Students learning book-binding at the Oakgrove School, Mussoorie.

Below right : Montessori class for boys and girls at a railway school.

> None of the highest posts are occupied by Indians, very few even of the higher. The position of a District Engineer, District Traffic Superintendent, or of an Assistant Auditor is, with one or two exceptions, the highest which Indians have hitherto attained. The detailed figures. . . .show that on the principal railways of the country out of 1,749 posts classed as superior, 182 or rather more than ten per cent are filled by Indians. Of the 182 Indians, 158 occupy posts as Assistant District Officers in the various departments; 24 have reached the higher grade of District Officers. That they have not been advanced to higher posts, that even in the subordinate posts of the official staff there are not more of them, has been a standing subject of complaint before us.'

As a result of the recommendations of the Acworth Committee and in response to strong public opinion expressed in the legislature, greater training facilities were progressively made available to Indians, and an increasingly greater number of Indians were admitted to higher posts. An Indian was taken as Member of the Railway Board and more were admitted in later years. A few Indians rose to positions of Deputy Commercial Managers, Commercial Managers, Deputy Agents and Agents. A few others rose to higher posts in the technical and engineering departments. Even then, up to the time of India's independence most of the higher posts remained a European preserve. The Europeans besides enjoyed salaries, gratuities, allowances, bonuses, leave facilities, home leave allowances and several other amenities, which according to British opinion were just adequate to attract suitable candidates from Britain, but according to Indian politicians represented a heavy drain on the resources of Indian Railways.

RACIAL PREFERENCE

In the lower services also certain amount of preference was shown for Europeans and Anglo-Indians. They were paid better salaries and were allowed better amenities and privileges than Indians for the same work. Europeans and Anglo-Indians lived in segregated colonies in railway towns. They were provided with superior type of quarters. Special arrangements were made for the education of their children. Separate institutions and clubs were reserved for their entertainment and relaxation, and even separate provision was made for medical service. All these distinctions disappeared after 1946. Merit alone determined a person's fitness for a particular job. As and when Europeans retired, suitable Indians were found to fill their places. While this has involved no change in basic salaries in the upper cadres, considerable economies have resulted from the discontinuance of special allowances and discriminatory facilities which had to be provided to European employees.

AMENITIES

A variety of amenities are provided by railways to their employees. Quarters are provided for a large number of railway workers of all classes. In railway

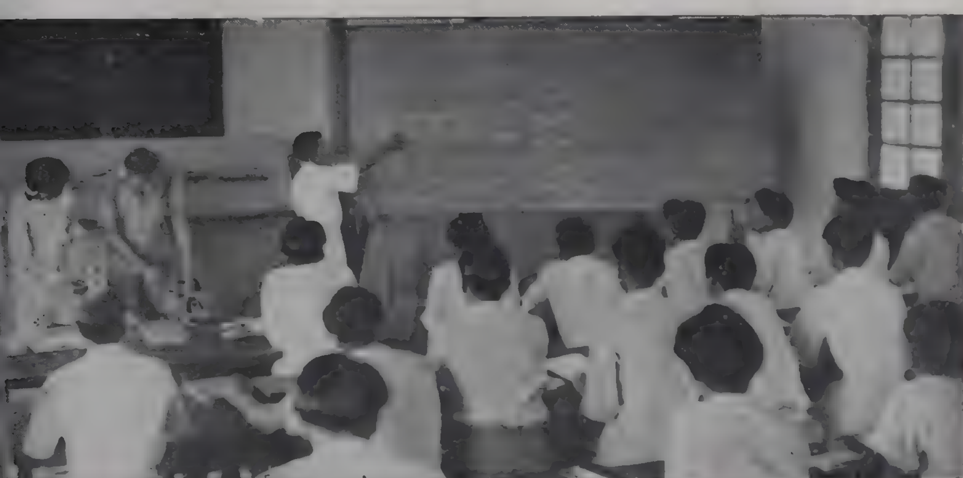
colonies and railway cities which exist all over the country, the basic standard is generally higher in these quarters in respect of space, ventilation, constructional design, sanitation, etc, than available to people of the same class living in the neighbourhood. In some of the recently constructed railway colonies and railway towns special consideration has been given to the style and standard of quarters for inferior staff, and the standard introduced therein is as high as in any other country in the East.

The railways maintain well-equipped hospitals, clinics, dispensaries, maternity and welfare centres where qualified officers not only attend to the needs of the employees but also of members of their families. At almost all the headquarters of District Medical Officers, facilities for dental treatment have been provided, and at some railway schools—a school health scheme has been introduced.

The railway medical department has hardly a parallel on any railway system in the world. With the recent division of the railway system in six zones, each zone has a Chief Medical Officer in charge of the zone. The zones are divided into divisions or districts depending upon the density of population and volume of traffic, etc. To take one example, in the Eastern Railway, the entire length of approximately 6,000 miles is divided into nine districts each in the charge of a District Medical Officer. The four big workshops in the zone at Kanchrapara, Kharagpur, Lillooah, and Jamalpur are separately placed under Medical Officers of District rank. Associated with the Chief Medical Officer, working at headquarters is a Malariologist, in charge of Assistant Malariologists, one for every zone for the prevention of malaria. Hospitals at the district headquarters and at the workshops are very well equipped and some are provided with as many as 150 beds. On every 50 miles of the route is a dispensary under the charge of a qualified Assistant Surgeon. On the Eastern Railway alone there are 110 dispensaries with 66 senior and 223 junior medical officers. These doctors look after the health of the employees and their dependants, and attend cases at headquarters and at wayside stations whenever required. At the dispensaries facilities are also available for vaccination for B.C.G., small-pox, anti-rabic treatment, and inoculation against typhoid, cholera and plague.

Besides offering medical aid to railway employees and their dependants, District Medical Officers and their subordinates look after the maintenance of sanitary conditions on railway stations, in railway colonies and towns, and in railway trains. They look to clean water supply, wholesomeness of articles of food, carry out anti-malaria activities, examine employees for fitness, supervise distribution of milk to infants and expectant mothers, and offer emergency treatment whenever and wherever required. In addition to the prompt medical aid made available at the workshops, which is the site of many accidents to the workers, by providing first aid cabins, the workshop medical officer supervises

Above : Instructor explaining layout of a double line station to students by means of a diagram in the Transportation Model Hall, Chandausi Training School.



Above : Training Apprentices, Loco Shops, Dohad.

Above : Educating the railway workers.

Below : Baroda College—Train working being demonstrated.

Above : Carrom tournament at a railway staff club.

Above : Coffee and Tea, being taken to different Shops for distribution in workshops, Perambur, Southern Railway.

Below : Reading room at a railway institute.

Above : Merry-go-round at the Children's Park, Railway Settlement, Asansol.
Below : Inside a railway grainshop

preventive measures to protect the workers from accidents and also train employees to the rendering of first aid to their co-workers.

RAILWAY COLONIES

In railway colonies and towns ample provision is made for entertainment and recreation. The railways take keen interest in sports. Railway Institutes which exist all over the railway system serve as the nuclei for social activity. The membership fee of railway institutes, considering the amenities provided, is almost nominal and is in proportion to the salary of the employee. At the institutes the standard of amenities, *i.e.*, provision for food, drinks, indoor and outdoor games, etc, compares favourably with any of the better class workers clubs abroad. The institutes have halls for cinema and theatrical shows, library and reading rooms, canteens, card rooms, swimming pools, provision for indoor games and for some such outdoor sports as, boxing, tennis, hockey, football, basket-ball, rugby and cricket. Railway hockey and football teams have won many national events during the last hundred years and have produced some of the finest players in the country. The Railway Sports Associations, next to the Army, have done more for Indian boxing than any other service. Railways have produced some of the front rank athletes, a number of national golf and tennis champions, and several star cricketers. Railway institutes have also taken keen interest in amateur theatricals and in ball-room and classical dancing.

TRAINING

The training of officers and skilled workers is a matter of special interest to the railways. Unskilled workers are generally recruited locally from the villages, but an elaborate system of apprenticeship exists on the various railways for training them as artisans, mechanics, machine-men, etc.

Training facilities for officers in the engineering and traffic departments are provided in several railway training and technical institutes. The more important ones are located at Jamalpur, Gauhati, Chandausi, Bina and Saharanpur. A historic function in terms of affording facilities for the training of higher staff for the Indian Railways took place on 31st January 1952, when the Staff College for Indian Railways was opened at Baroda by the then Minister for Railways, Shri Gopalaswami Ayyangar. A former palace of His Highness the Maharaja Gaekwar of Baroda was selected to house the college. Facilities have been provided at the college for the training of officers for the transportation and the commercial departments and for offering refresher courses for junior officers in railway service wishing to study various problems of railway operation.

Besides offering these facilities to their senior and junior staff, railways offer special stipends, study leave and study allowances to selected cansidates for study

abroad. Opportunities are also afforded to senior railway officers to proceed to foreign countries on deputation to study modern developments in railway engineering and operation.

The railways have not been unmindful of their obligations to the children of railway employees. Hundreds of primary schools for boys and girls, a large number of middle and high schools, special schools run on the model of British public schools for those who can afford the expense are run and managed by the railways. Some are substantially subsidised by them. The educational budget of the railways every year is equal to, if not greater than, the education budget of some of the States of the Republic.

XIX. Passenger Traffic

MAHARSHI DEVENDRA NATH TAGORE, the illustrious father of India's great national poet, Dr Rabindra Nath Tagore, describes in his autobiography a journey undertaken by him from Calcutta to Simla in 1856. The first part of the journey was made by boat up to Banaras. The boat hire was Rs 100.

'It had taken us nearly a month and a half,' wrote the Maharshi, 'to get to Banaras from Calcutta.' From Banaras he left by a coach for Allahabad reaching the right bank of the Ganga the next evening. 'On reaching the right bank at Allahabad,' wrote Devendra Nath Tagore, 'I had my carriage hoisted upon a ferry boat for fear I should not get one early in the morning. I slept that night on the boat inside the carriage. Next morning the ferry boat started in a leisurely way and reached the opposite bank at noon.' A fourteen day journey by coach brought him to Agra. 'My stage coach,' he writes, 'used to travel day and night; in the middle of the day we would cook and eat our meals under a tree.' The journey from Agra to Delhi was done by boat in one month. As indicative of the speed of the boat he remarks, 'the boat went its way, but I used to walk along the bank of the Jamuna through corn fields, villages and gardens enjoying the beauty of nature.' From Delhi he made the journey up to Ambala by coach and by 'jhampan,' a sort of sedan chair, up to Simla.

EARLY TRAVEL

In 1849, Dr Honiberger, a physician attached to the Court of Maharaja Ranjit Singh, made a boat journey from Garhmukteswar to Calcutta which took him two months. The boat hire was Rs 1,300. In his book *Twenty Five Years In The East*, Honiberger describes the number and variety of river craft plying up and down the river in those days. He saw 'pinnaces for two to five passengers, budgerows for two to six passengers, cutters and bawlehs for single passengers, panseys and palwas for four to five passengers, and baggage and cargo boats. Besides private river craft, there were Government 'iron steamers' plying between Calcutta and Allahabad and carrying both cargo and a limited number of passengers.' Statistical returns quoted by Bourne from the record of a toll office

on the Ganga for the year 1844-45, estimate the number of passengers who travelled by boat between Banaras and Calcutta as 60,000, and the cargo carried by Government steamers valued at Rs 175,88,000.

The first 'dak' (mail cart) service was inaugurated by the Postmaster, Mr Jardine, in 1831. The mail coach took 48 hours to make the journey from Bombay to Poona, and the charge per passenger according to Rousselet was Rs 90. The first regular long distance public road transport was introduced in November 1841, between Aligarh and Kanpur. By 1845, mail carts were running from Calcutta to Lahore, and Bombay to Surat and Poona. By 1850, bullocks were replaced by horses and several companies were formed to run this horse 'dak' service. The first amongst these, the Inland Transport Company, was started in Kanpur by a wealthy Indian named Tanti Mal.

HIGHWAY DANGERS

Apart from being costly, slow and uncomfortable, journeys by road were far from being safe. There was always a danger of wild beasts. Owing to unsettled conditions, organised bands of robbers and thugs freely operated during the later period of the Moghul Empire and the earlier period of the British rule in various parts of the country. Colonel Taylor and General Sleeman writing in the late thirties, give some very blood-curdling descriptions of the manner in which these dacoits and free-booters operated on the highways. 'The thugs reigned the highways,' writes Sleeman, 'and under the guise of friendship win the confidence of unsuspecting travellers and after accompanying them for a stage or two, on reaching the first selected and retired spot, murder them by strangulation and plunder their property.'

Before Maharshi Devendra Nath Tagore died, he had travelled from Calcutta to Banaras by train, making the journey in less than 15 hours. The third class fare between Calcutta to Banaras then was Rs 6 as 9 and the first class fare Rs 26 as 5. Rousselet in 1879 travelled from Calcutta to Agra and back making the entire journey in seven days including a 24 hours' halt at Agra. According to him, in spite of the heat the journey was comfortable—'even luxurious.'

FIRST RAIL JOURNEYS

The Bengal Hurkuru of 23rd August 1854, gives some amusing 'first impressions of railway travel' of some of its readers. 'Roop Chand Ghose, a flourishing dealer in piece-goods and perfumery,' when set down at the end of the journey after he had arrived at Hooghly, felt strongly suspicious and went down the street asking several people as to the name of the place he had reached. It 'took a long time before the conviction gained upon him that verily he had come to Hooghly.' Pandit Radhalunkur Banerjee, 'after duly consulting the stars,'

undertook his trip up to Hooghly 'but declined to undertake the return journey,' because said he, 'too much travelling on the car of fire was calculated to shorten life. Seeing that it annihilates time and space and curtails the length of every other journey, it must shorten the journey of human life.' There was then the case of one Mr Jones who had made trips to Hooghly and back three successive days. 'Having acquired a notion of speed, such as he never knew before, he can no longer reconcile himself to the jog trot of his buggy horse, and accordingly does nothing but whip the poor brute in the vain hope of making it go at something like railway speed.'

PASSENGER DATA

During the first sixteen weeks, the East Indian Railway carried at an average 7,000 passengers a week, the number registering an increase to 12,000 a week when in 1855 the line was opened up to Raniganj. The figures of 1870, after the Ghats inclines had been opened to traffic, show that the number of passengers both to and from Bombay City during the year had risen to more than two million.

To start with, the fares from Howrah to Hooghly were Rs 3 for the first class, Re 1 as 2 for the second class, and As 7 for the third class. On the Great Indian Peninsula Railway the fare from Bombay to Thana in 1853 was Rs 2 as 10 for the first class, Re 1 as 1 ps 6 for the second class and As 5 ps 3 for the third class. The third class fare was approximately three pies, or less than a farthing, a mile.

Comparative statistics of average fares of various countries show that Indian fares have been the lowest, except during the thirties when Japan had a tariff rate lower than that of India; the average rate per mile in India then being 3·25 pies as compared to 2·5 pies in Japan. Rates on the railways in the United States, Canada and Great Britain were anywhere between three to six times those of India.

As the number of lines multiplied and route mileage increased the number of passengers also showed a spectacular rise. In 1901, the East Indian Railway had carried 24 million passengers. The number had risen to 42 million in 1916-17. Ten years later, the figure had shot up to 72 million. The total number of passengers carried in 1951-52 on all Class I railways was 1,247·3 million, the passenger miles being 39,030 million.

CLASSES

The first railways had only three classes, first, second and third. Later, the third class, which had wooden boards for benches, was converted into the intermediate, and the new third class consisted only of open trucks. At one time British experts apprehended that it would be impossible to attract passenger traffic in a country where the economic standard of a large number of people was very

low, and that even if people were persuaded to travel, a large number of classes will have to be provided 'because of the prevailing religious caste and racial differences.' Both these apprehensions were belied by experience. The steep rise in passenger traffic from year to year on all railways, nine-tenths of which represented third class passengers, showed the general popularity of travel by rail. The third class passengers, representing nine-tenths of the total number of passengers, irrespective of caste, creed or religion, travelled together in one class. Certain distinctions for providing special accommodation to Europeans and Anglo-Indians were finally abolished twenty years ago as a result of strong popular criticism in and outside the legislatures.

First and second class passengers during the last hundred years have enjoyed a standard of comfort and amenities comparable with those obtaining on the best railways in the world, at an appreciably lower rate per mile. First and second class compartments mostly consist of two to four berths, and generally have separate toilets attached. Provision is made for shower baths for first class passengers. Comfortably furnished waiting rooms and retiring rooms were all along available at all important stations for upper class passengers along with ample provision for their meals in dining cars attached to trains and restaurants at intermediate halts.

THIRD CLASS PASSENGERS

Of the total number of passengers in 1951-52, those travelling in air-conditioned coaches totalled 25 thousand, in first and second class 19,971 thousand and intermediate 22,418 thousand. As against this, a total of 1,204,900 thousand travelled by the third class. Upper class passengers all put together were three and a half per cent of the number of third class passengers. In earlier years the fare was the only incentive provided to third class passengers. Starting with a fare of three pies per mile at one stage, the fare was reduced to one and a half pies per mile for distances of 100 miles and above in 1897. As a result of several revisions the fare now stands at five pies per mile for ordinary trains and at six pies per mile for mail or express trains.

For several years after four classes had been created, third class carriages were just bare open trucks in which passengers sat on the floor. In due course benches were provided but it was not till 1891 that lavatories were introduced in third class coaches. 'It was not then seen,' wrote Huddleston, 'that it was to this third class traffic that the subsequent success of the Indian Railways would be so highly indebted. The third class affords in fact in India the backbone,' further observed Huddleston, 'being nearly the whole body of the coaching receipts; the other classes might as far as profit is concerned, be abolished. Indeed on most lines the removal would be a positive gain.' Describing the state of

Above : Circulating Area—Kumbha Mela at Hardwar—1950.

Below : Passengers getting out of station—Kumbha Mela at Hardwar—1950.

Above : Booking and Reservaiton office at Fairlie Place, Calcutta.

Below : Chanda Platform.

The interior view of a lower class carriage.

Above : Refreshment Stall at Arkonam, Southern Railway.

Below : Provision of drinking water for passengers at Burdwan Station, Eastern Railway.

affairs on Indian Railways during the early years of the present century Huddleston wrote: 'Just stand some evening on a fairly filled platform and watch the confusion; hear the shouting, wrangling and disputes; see the struggle to entrain, the push and scrambling. And when you have seen it all don't throw the blame on the unfortunate third class passengers.' Continuing he remarked: 'Difficulties of the third class passenger, by far the most predominant and remunerative of all, would be greatly simplified if there were only three classes, first, second and third, easily distinguishable rather than four . . . It should also be remembered when talking of three or even four classes, that it is not unusual to find in some Indian trains, refreshment cars for Europeans, besides separate compartments for Hindu and Muslim refreshments, postal vans, ice vendors, compartments for women only, private saloons for high officials of Government, big Indian potentates or railway officials. In a word, an Indian train is generally a conglomoration of vehicles mixed up anyhow, why not then do something material to simplify it?'

Indian public opinion continued to demand better amenities for third class passengers, but progress in this respect was neither rapid nor radical. Substantial changes have, however, taken place during the last five years. While much still remains to be done to afford to third class passengers the amenities available to the lowest class of passengers on railways in the United States, Canada, Great Britain and Germany, third class travel is no longer the hazard or the ordeal, which it used to be even during the days of World War II. Less than ten years ago, fans in intermediate compartments were rare. Today, a large number of third class and inter class compartments on Class I railways are equipped with adequate number of fans. Lavatories are larger, cleaner and better fitted, and have ample provision for water in the tanks. Seating arrangements have been considerably improved offering increased comfort and leg room to the passengers. Lighting is considerably better. By a process of rationalising, long distance and short distance travel, provision has now been made for reserving intermediate and third class accommodation for long distance passengers. Several long distance fast trains and shuttles, only for third class passengers are now run to relieve lower class traffic congestion. At great expense, on almost all important stations, covered platforms have now been provided. A large number of new waiting halls have been constructed for lower class passengers at many stations. Microphones have been installed on many important stations for announcing the arrival and departure of trains. Special guides have been appointed to help illiterate passengers in finding trains and in getting appropriate accommodation.

CATERING

Catering arrangements on Indian Railways, so far as upper class passengers

were concerned, have always been excellent. During the last five years, the emphasis has been on improving catering facilities for lower class passengers. Well cooked Indian meals at cheap rates are now available in all dining cars. Hundreds of vegetarian and non-vegetarian refreshment rooms, all over the railway system, provide hot meals at reasonable prices. Tea and coffee stalls, vendors selling sweetmeats, fruits, cold drinks, etc, abound even on moderately small stations. Clean drinking water is available on all stations. At several of the important stations large refrigerators have been installed to provide cooled water for passengers. For the lower class passengers during the hot weather, this has proved a great blessing. Booking offices have been enlarged and the staff adequately increased to expedite issuing of tickets.

XX. A Tourist's Paradise

INDIA is a wonderful country for travel. It is a country of long distances. It is a land of sunny skies and perennial snows with a climate which varies from place to place during different parts of the year. India has a long range of mountains having several peaks which are the loftiest in the world. In sheer picturesqueness of their natural scenery, there is nothing comparable in any other part of the globe. India's mighty rivers, their numerous tributaries and canals, form a network of waterways meandering through vast endless stretches of fertile fields, creating a landscape as colourful as the imagination of any painter can conceive. It has more than 3,000 miles of dented coast-line, with some of the finest bays and beaches in the world. India abounds in tropical jungles having a rich variety of fauna and flora. Here nature expresses itself in generous profusion and gay abundance.

HISTORY IN STONES

It is not only in the varieties of its climate, the majesty of its mountain peaks, the beauty of its landscape, the richness of its forests or the picturesqueness of its sea coast, that the fascination of India lies. India is a country of hoary tradition with thousands of years of history carved in stone, stucco and marble, in the excavated ruins of old cities and in many temples, forts, palaces, mosques, churches, mausoleums and caves, which in architectural conception, in the magnificence of their construction and in the artistic details of their ornamentation, occupy an honoured place among the structural wonders of the world.

India is also a country of contrasts. In certain phases of life it is as modern as any of the advanced countries of the world. And yet in several others it preserves the ways of life and the customs and traditions of a thousand years ago.

India is a paradise for tourists and has attracted explorers and travellers since very early times from various parts of the world. Indians themselves have been and are great travellers. Fa-hien, Hiuen-tsiang, Magasthenes, etc, who visited India almost 2,000 years ago, have left records of their travels which show that even under travelling conditions then existing, Indians in their thousands journeyed

by foot, by boat and by various animal-drawn vehicles, to the many places of pilgrimage or of natural beauty all the year round. They also saw a large number of foreign visitors and traders in the country.

With the advent of railways travelling became easy and comfortable. The journeys which took a fortnight or a month, could be done in a day. This enabled pilgrims and travellers to move about more freely and more frequently. Pilgrim traffic during the last hundred years has continued to increase and has been an important source of revenue to the railways. It has also posed its own special problems to railways in India. Almost all the ancient and sacred shrines which attract pilgrims are located in places, which by themselves are a source of attraction to travellers because of their climate and the rich beauty and picturesqueness of their scenery. Quite a large number of them are approached by railway stations where the normal traffic is small. The times for pilgrimages differ from place to place, and generally synchronise with the period when weather conditions are most suitable and nature is at her best. Thus it happens that a station normally serving a population of 15,000 to 20,000, where a few trains pass during the day, discharging 100 to 200 passengers, would during the period of a pilgrimage or a fair by expected to receive, besides the ordinary trains, a large number of special trains and tens of thousands of passengers daily.

PILGRIMAGES

The Kumbh Mela is typical of these big festivals. It is held in four centres, Nasik, Ujjain, Prayag and Hardwar, being celebrated in rotation at each centre every twelve years. In 1950, it was held at Hardwar which has a population of 100,000. During the period of 12th March to 21st April, the number of pilgrims who came to Hardwar was estimated at a million and a quarter. Nearly fifty per cent of these reached by train. Of these a very large proportion arrived during the peak nine days of the Mela. The maximum number of pilgrims who arrived in one day was 122,000, being 5,083 per hour. The outward traffic during the closing week of the Mela involved dispersal of almost the same number of passengers. Besides ordinary trains, the station staff had to handle as many as 37 special trains during this period. All this rush involved elaborate arrangements for sanitation, watch and ward, and other amenities for booking and checking of tickets, for planning the arrival and departure of trains in quick succession from different directions, and the greatest care and caution to prevent bottle-necks and accidents.

Apart from the Kumbh Mela, hundreds of important fairs and festivals are held all the year round at numerous places of pilgrimage for Hindus, Buddhists, Muslims, Sikhs, Parsis and Christians in various parts of the country. Many of these are attended by hundreds of thousands of people and require special

arrangements, for which a great deal of planning is normally required. Arrangements have to be made for incoming and outgoing special trains, for the shelter and comfort of passengers, for issuing tickets and checking their luggage, for sufficient supplies of water and food, for providing emergency medical aid and for sanitation to prevent the spread of diseases or outbreak of epidemics.

These mass movements of visitors are a daily feature of Indian life, and railway officials after years of experience, have come to look upon the various complex problems attending these fairs and festivals as a part of routine activity.

TOURIST ATTRACTIONS

The foreign tourist finds many attractions in India. There is Kashmir, India's best holiday resort, whose scenic beauty and variety are unexcelled. There is no place where, as Sir Francis Younghusband wrote, one can see a complete circle of snowy mountains surrounding a plain of anything like the length and breadth of the valley of Kashmir at the back of which stands a region of stupendous mountains surpassing every other in the world. The frescoes of Ajanta, the sculptural carvings of Ellora and Elephanta, the ornamental monolith pillars in the temples at Rameswaram, Madura, Srirangam, Konarak and Puri, the lofty domes of the temples at Bhubaneswar and Dwarka, the artistic subtleties of the filigree studded marble palaces of Rajputana, and the grandeur and majesty of some of the later Moghul buildings like the Taj Mahal at Agra and the Red Fort in Delhi, offer not only a pilgrimage into the pages of ancient history but also a delightful study in the architectural achievements of man.

Lovers of sports find in India much to enjoy themselves. Some of the finest duck shooting is available in such places as the Chilka lakes in Orissa and the lakes of Kashmir. Snipe, partridges, pheasants and quail are available in several parts of the country. Thick jungles peppered all over the country offer extraordinary opportunities for big game hunting. The Gir forest in Junagadh is world famous for its lions. Panthers, tigers, leopards, bison, bear, wild boar abound the forests in various parts. Elephant hunting is still possible in Mysore and Assam. India's coast-line and its numerous rivers and lakes offer plentiful opportunities for fishing, boating, yachting and surf riding. At some of the hill stations, especially at Gulmarg, in Kashmir, arrangements exist for winter sports.

TOURIST SERVICE

Before World War I, a Tourist Bureau existed in London. The Acworth Committee, however, recommended more active measures to attract tourists and another Bureau was opened in New York. The Wedgwood Committee recommended the enlargement of the work of these centres, and also suggested the appointment of Public Relations Officers by the various railways to encourage

tourist traffic and to help visiting tourists. During the thirties, a large number of hand-books, brochures and other attractive literature were published for display and circulation respectively in various countries through these centres and the travel agencies.

It was in 1948, however, that the railways acting in collaboration with other interested departments in the Ministry of Transport, took special steps for attracting tourists from abroad. An 'ad hoc' Tourist Traffic Committee was set up consisting of representatives of the Ministries concerned and of Tourist Transport and hotel industries. A year later, a Tourist Traffic Branch came into being in the Ministry of Transport. The Tourist Traffic Branch opened a chain of regional tourist offices in some of the important cities and tourist centres. Besides these, the various railways have at the headquarters and at various key tourist centres, their own Information Offices under the charge of competent tourist officers, to supply necessary information to tourists, to plan their tours and to reserve accommodation for them in railway trains, and to make advance booking for them in retiring rooms or hotels. In some of the tourist centres like Ranchi, Puri and Aurangabad, railways run their own hotels. At most of the important stations accommodation is available to tourists in retiring rooms which are not only elegantly furnished but are also available at very reasonable rates.

TOURIST COACHES

Special arrangements are made to reserve accommodation in ordinary trains for foreign tourists. Parties of tourists also can have at concessional rates tourist cars which have all the advantages of a hotel with all the comforts of a *de luxe* carriage. On these cars the tourists can have their own personal servants and their own direct continuous service and meals, whenever wanted, from an attached kitchen. The cars are generally supplied with crockery, table linen, cutlery, a refrigerator, bed linen and towels. Besides providing sleeping accommodation for eight persons on the broad gauge system and for six on the metre gauge, a tourist car has a spacious parlour, bunks for the servants and attached bath-rooms and toilets. Passenger carriages can also be reserved by parties of tourists for specially planned tours. Parties of students and sportsmen are given substantial concessions when travelling together to the same destination.

Those competent to judge are of the view that an eight or twelve weeks' holiday in India, apart from offering some of the finest attractions available in any one country in the world, costs no more in travelling, board and lodging and other expenses than the actual hotel expenses a person would incur during this period in some of the better class hotels in America or Europe. Journeying in India is rich in its attractions, and rail travel is comfortable and perhaps cheapest as compared to other countries.

XXI. Goods Traffic

ALTHOUGH THE PUBLIC AT LARGE may regard the railways principally as a means for transporting passengers, it is the merchandise traffic which contributes to the larger part of their total income. During 1951-52, of the total gross income of Rs. 294 crores of the Indian Railways, merchandise traffic contributed as much as Rs. 158 crores, nearly 54 per cent of the total. It is interesting to recall that the East Indian Railway carried, during the first year of its working, only 27,213 tons of goods. As against this, during 1951-52, the railways in India carried a total of 98 million tons. The development has been phenomenal.

Conceived primarily as commercial concerns, the railways have always endeavoured to levy charges for goods traffic at such a level as to produce sufficient revenue to meet the ordinary cost of operation, depreciation and interest charges, and also yield a margin of profit compatible with the nature of the undertaking. The task has, however, been far from easy.

WHAT RAILWAYS CARRY

Railways carry a heterogeneous variety of goods; raw materials, finished products, perishables, goods in bulk and in bags, liquids, articles of high value and low, fragile and dangerous goods, building materials of all kinds, medicines, chemicals and drugs, clothing, footwear, and essential foodstuffs, and in fact every article and commodity that either directly or remotely enters into the daily life of the average person. To fix the charges for the transportation of such diverse varieties of goods over different distances and under varying conditions, is clearly a matter of great complexity. On the one hand the transportation characteristics such as value of the goods, bulk in relation to weight, risk in transit, etc, have to be given due weight, and on the other the cost of transportation has to be taken into account. A reliable method of ascertaining the cost of transportation of a particular commodity has, however, not so far been established owing to the joint character of costs involved in the service and the variety of conditions of transport.

In the beginning, the various railway companies etc, were left to determine

their own basis of rates for different commodities based on their own commercial judgement and there was naturally little uniformity in the matter. The usual method, of course, has been to group commodities in different classes, so that commodities having sufficient degree of affinity of transportation and economic characteristics are grouped in the same class, the charge for each class being different.

The earliest classifications used on Indian Railways were simple and could be printed on a sheet of foolscap paper. The number of commodities offering for carriage was limited. As development took place, the classifications grew in size rapidly and by 1873, the classifications in force on the East Indian Railway ran into 13 pages, while in 1889, the goods classifications had increased to 109 pages of closely printed matter.

EARLY RATES POLICY

In view of the monopolistic character of rail transport, Government control over railway rates was exercised from the early stages. Basically, this took the form of the fixation of maximum rates to protect the public and to prevent levy of unreasonable charges on the part of the railway administrations, and of minimum charges mainly perhaps to ensure that the companies which were operating under arrangements in which the Government had guaranteed a certain amount of profit, did not quote rates below their cost of operation.

In March 1883, in a resolution No. 162 (Railway Traffic), these principles were finally enunciated. The Government of India laid down that the cost of carriage should be one of the limits within which rates may vary, and the tax which the trade will bear being the other. In the determination of the rate they further pointed out that it was necessary to consider the whole circumstance of the traffic dealt with as regards empty running, the intermittent nature of it, and the effect of competition by other routes. 'Telescopic' rates, *i.e.* those with the basis decreasing with increase in the distance, were recognised as legitimate in all cases where the particular traffic would be lost without such rates. The financial justification for telescopic rates rests on the lower proportionate cost of the longer lead. It was observed by Government that the rates had to be eventually governed by the necessity of attracting the maximum quantity of traffic the line could carry and not by any arbitrary standard of profit which must be achieved.

PRINCIPLES DEFINED

Later on, in the observations preceding the famous resolution of the Government of India dated 12th December 1887, the following four principles were enunciated for the purpose of fixation of rates on Indian Railways.

Principle I—That to protect the public and to prevent unreasonable charges

on the part of the railway administration, it was necessary for the Government to impose restrictions as regards the maxima fares to be levied for the carriage of all classes of passengers and the maximum rates incidental to the business of carrier.

Principle II—That the charges made to the public are admissible of division into two heads; (a) mileage rates and fares, which necessarily vary to some extent, with the distance the passengers and goods are carried; and (b) terminals; this latter being a fixed charge for business, incidental to the business of a carrier.

Principle III—That when once minima and maxima fares and rates have been fixed, any further interference on the part of the Government in the matter of fares and rates is only a restraint on trade. The railway administration, who know their interests best, should be allowed to alter their rates within the prescribed maxima and minima to suit the various conditions under which commercial business is everywhere carried out.

Principle IV—That, although in the interests of the public, the Government should abstain from direct interference in the matter of rates and fares, yet there are certain ruling principles, which Government as the guardian of public interests must see complied with by the railway administration. There should be no undue preference; in other words, railway administrations ought not to be permitted to make preferential bargains with particular persons or companies, such as granting them scales of charges more or less favourable than those granted to the public generally. Again, in cases where the traffic offering is sufficient to justify this arrangement, railway administrations must give reasonable facilities for public traffic between any two railway stations, each railway administration being contented to receive for its share of the through rate, less than its ordinary local rate.

INDIAN RAILWAYS ACT

The Indian Railways Act which was passed in 1890 followed generally the same lines.

While the railways were free to levy such charges as they considered fit and reasonable, the growing interchange of traffic pointed inevitably to the necessity of a general classification for uniform application on the different railways. The first such general classification of goods was made applicable over railways which were parties to the Indian Railway Conference Association and was introduced on 1st July 1910. There were only five classes in it with an additional class for explosives and dangerous goods. The bases of these class rates were as follows:

Class	Basis per maund per mile
I	0·333 pie
II	0·500 ,,
III	0·666 ,,
IV	0·833 ,,
V	1·00 ,,
For explosives	1·500 ,,

The need for additional revenue for the Government became urgent with the outbreak of the First World War, and a Government surcharge was accordingly levied at the rate of one pie per maund on coal, coke and firewood, and two pies per maund on all other articles.

In 1921, a primage charge of two annas six pies per rupee of freight was levied instead, on all goods traffic excluding grains and pulses, firewood and fodder. This may be taken to be the first instance where the Government treated railway freight rates as a possible means of augmenting the Government revenue besides, of course, the income from a railway wholly owned and worked by the Government.

From 1st April 1922, it was decided to merge this primage charge in the basic rates simultaneously with the increase of the number of classes to ten. The bases of these classes are given below:

Class	Basis per maund per mile	Class	Basis per maund per mile
1.	0·38 pie	6.	0·83 pie
2.	0·42 "	7.	0·96 "
3.	0·58 "	8.	1·04 "
4.	0·62 "	9.	1·25 "
5.	0·77 "	10.	1·87 "

The class rates usually represent the maximum rates chargeable for a commodity, and it became necessary on certain railways to levy charges at a somewhat lower rate for certain commodities. To ensure uniformity in respect thereof on the railway system itself, a system of schedule rates was provided. The bases of most of the schedule rates were telescopic and tapered with increase in distance over each railway separately.

During the fourteen years that this classification remained in force, it was observed that the classes were not evenly spread, and a proper relativity did not exist between the rates at Railway Risk and Owners' Risk. This was the subject of a certain amount of public criticism. From 1st May 1936, therefore, six new classes were introduced and the relativity in the Railway Risk and Owners' Risk rates was also brought on a more rational footing, although not representing exactly the difference in the actuarial value of the risk involved. The bases of the new 16 classes were as follows:

Class	Basis per maund per mile	Class	Basis per maund per mile
1.	0·38 pie	4B	0·72 pie
2.	0·42 "	5	0·77 "
2A.	0·46 "	6	0·83 "
2B.	0·50 "	6A	0·89 "
2c.	0·54 "	7	0·96 "
3.	0·58 "	8	1·04 "
4.	0·62 "	9	1·25 "
4A.	0·67 "	10	1·87 "

With effect from 1st March 1940, an increase in charge of two annas per rupee of the total freight charges was levied on all goods traffic excluding foodgrains, manures, fodder, etc.

NEW RATES STRUCTURE

With the nationalisation of all important Indian Railways it was no longer possible to resist the public demand for the introduction of telescopic rates on through distance over the different railways. Consequently, during World War II, a comprehensive analysis of the rates structure was started. As a result of four years of labour of the special organisation set up for the purpose, the rationalised rates structure at present in force was introduced with effect from 1st October 1948. The new rates structure provides for 15 class rates and about an equal number of wagon load scales of rates, each with the basis declining with increase in distance over the Indian Railways as a whole. Traffic now moves by the shortest route at the cheapest rate to the maximum possible extent. The new rates structure does away with the increase in charges imposed during World War II, and aims at rationalisation and simplification of rates calculation. It also represents a modest increase in rates generally, as it became necessary to augment revenues to meet the increased operating cost of the railways.

Besides Government control, another important factor which influenced the rates charged was competition either with other forms of transport or with other railways. In fact, as early as 1861, a representation was received from traders in Calcutta pointing out that the rates for produce between Upper India and Bombay were injuring the trade of Calcutta. The companies running the two alternative lines for Bombay were guaranteed agreed profit by the Government and did not mind reducing their rates so long as they did not infringe the minimum fixed by the Government, more especially as there was then but little prospect of their yielding return in excess of the guaranteed rate of interest. While to an extent competition did exercise a healthy influence, it tended some times towards unhealthy competition resulting in a complicated rates structure with a multiplicity of special rates applicable between specific pairs of stations for specified commodities. In the end, a large number of reduced rates to and from the ports found their place in the railway tariffs. This naturally led to the general public complaint that the railways were fostering the export of raw materials and import of finished products to the detriment of the development of indigenous industry. Attempts were, no doubt, made to justify this position by stating that the lower rates of freight to and from the ports were quoted on ordinary commercial considerations. It was explained that the indigenous industry did not in the past possess the capacity to consume the vast supply of raw materials available in the country, and the considerable exportable surplus thus had to find a market overseas.

Similarly, until the country became self-sufficient in the manufacture of consumer goods, import of finished products had to continue. In the circumstances, it was said that the assistance given by the railways in the form of reduced rates in the development of such export and import traffic was mainly to augment their own revenues. The Indian Industrial Commission (1916-1918) also considered in detail the effects of the prevailing railway rates on industrial development, and while they were not inclined to endorse the view that freight rates were fixed by some of the railways intentionally or solely to help foreign interests, they did feel that the natural preference of railways for a large volume of traffic which flowed to and from the ports resulted in certain concessions and preferences which indirectly had the effect of benefiting the export and import trade.

With the rationalisation of the railway rates structure in 1948, it was unequivocally laid down that export and import traffic should be treated on a par with internal traffic. The question of any preference thus finally ended.

RAILWAY RATES TRIBUNAL

Provision already existed in the Indian Railways Act banning undue preference to, or prejudice against, any particular party or traffic. The Acworth Committee in 1921, however, recommended the establishment of a Rates Tribunal, to adjudicate upon disputes between railways and the public, in the matter of rates. The Government of India were, unable to accept this recommendation, as

(i) the constitution of a body empowered to pass final decision on points referred to it would involve an amendment of Chapter V of the Indian Railways Act;

(ii) as Government were responsible for a commercial return from railways, it was not proper to have a Rates Tribunal exercising control over rates in the sense of fixing such rates.

The matter was discussed with the Central Advisory Council for Railways in 1923, and after further consideration, a Railway Rates Advisory Committee was established in 1926. Although the Railway Rates Advisory Committee did useful work and their recommendations were accepted by Government in most cases, commercial interests continued to demand the establishment of an independent Railway Rates Tribunal. In deference to this persistent demand a Railway Rates Tribunal was set up in 1949. The functions and the constitution of this Tribunal appear in Sections 34 to 46C of the Indian Railways Act, 1890.

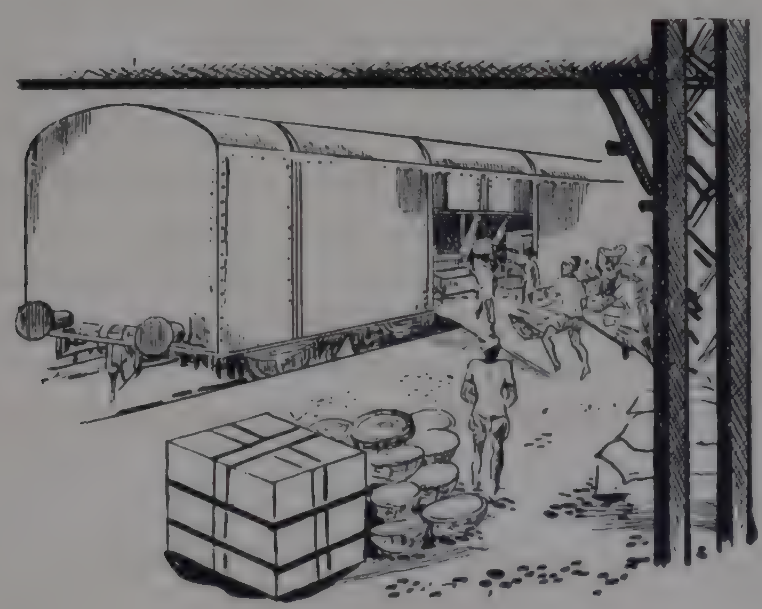
NATIONAL DEVELOPMENT

The contribution of the railways in the economic development of the country has been as phenomenal as the development of the railway system itself. Wherever new lines were opened, economic activity followed, and even up to the present day,

demands for construction of new lines are usually associated with the justification for developing certain backward areas. Furthermore, liberal concessions in freight rates have been granted by the railways for the development of industries. Although the lower limit of the rates to be charged is usually considered to be the cost of operation, the railways have even gone below this in the case of a basic requirement of industry like coal which is even now carried at below the cost of operation. The principle of levying charges generally on 'what the traffic will bear' has tended to encourage the maximum movement of all commodities. Unless goods of high value are made to pay more, commodities and articles of low value including foodstuffs and industrial raw material, which cannot afford to pay more, would hardly move freely.

Railways have made an important contribution towards the development of the iron and steel industry by quotating suitably low special rates. Some of these rates were as low as 1/15th pie per maund per mile for the raw materials of this industry, and 1/6th and 1/10th pie per maund per mile for the manufactured articles. These low rates were quoted about the beginning of the present century and have remained in force for about twenty-five years. Even now these continue to remain substantially below the ordinary class rates. Concessional rates were also extended to the raw materials and finished products of cement, chemicals, glass, sugar, and paper industries. Nor has the railway's contribution to the development of agriculture been any the less. Low scales of rates were provided practically over all the railways for the transport of organic and chemical manures.

The development of industries and agriculture has, of course, been to the mutual interest of both the industries and the railways.



XXII. Development of Industries and Postal Services

DURING THE LAST HUNDRED YEARS India, like some of the other progressive countries of the world, has developed rapidly in various ways. It is difficult to assess the influence railways have exercised towards this progress. But it would be no exaggeration to claim that the railways have been a very important contributory factor in accelerating the pace of national advance, in enlarging the opportunities for political and social changes, and in building up the economic fabric of the country. By providing a network of a speedy, safe and cheap transport system, railways have enabled large masses of people to travel from one part of the country to the other, and have made it possible to transport ever-increasing quantities of every variety of merchandise and goods from remote villages to the centres of trade all over the world and *vice versa*. The impact of railways has altered the travel habits of people, broken down the barriers of isolation surrounding small communities, enlarged the facilities for educational development, and brought within reach of the common man and woman greater opportunities of diversified and better employment. Railways have promoted enormously the internal and external trade of the country and have revolutionised the nations agricultural economy. They have facilitated the development of numerous industries and assisted the economic progress of the country towards self-sufficiency. With the advent of railways obscure villages have grown into towns; several towns into big cities and some of the big cities have become so large as to compare favourably in population, area and modern amenities of life, with some of the major metropolitan centres of the world.

INDUSTRIES

Cities Like Delhi, Allahabad, Patna, etc, even though they can trace their origin as the capitals of great empires, to several centuries before the Christian era, were even during the fifties of the last century, small townships as compared to modern standards, with population ranging from 50,000 to 200,000. The

population of these and other similar cities has multiplied four to five times. Industrial centres such as Kanpur were obscure townships before the railways started, while Jamshedpur, Bangalore and Asansol did not exist. The three major port towns, Calcutta, Bombay and Madras even though they were the centres of export and import trade, had hardly any industries. The last haundred years have witnessed rapid industrialisation of the country. India is today the largest manufacturer of jute, and one of the foremost manufacturers of textiles and silk. It occupies an outstanding position in the East as the manufacturer of iron and steel, sugar, cement, heavy chemicals, pharmaceutical products, and a large variety of consumer goods. The country has not only been able to move rapidly towards industrial self-sufficiency, but has also built up a sizeable export trade for several of its manufactured products.

It was only when railways started that it was possible to experiment with the cultivation of tea on a large scale in Assam and other parts of the country. Today, India is not only one of the greatest consumers of tea, but is also one of its largest exporters. In 1952, railways carried from Assam alone 143,300 tons of tea.

Up to a little over twenty years ago, India was an importer of refined sugar. Sugar-cane cultivation was just sufficient for manufacturing small quantities of unrefined varieties in the rural areas. Today, Indian sugar mills manufacture all the refined sugar which India needs, leaving periodically a substantial surplus for export. Sugar-cane cultivation has become widespread and has altered rural economy in such states as Bihar and Uttar Pradesh.

COAL

The story of coal is perhaps the most interesting. The first published reference to the mining of coal dates back to the year 1774, when shallow mines are reported to have been developed in the Raniganj field. During the year 1855-56, after the East Indian Railway had extended the line up to Raniganj, 100,000 tons of coal were transported from Raniganj to Calcutta. By 1860, however, 50 collieries were functioning, producing about 282,000 tons of coal annually in the Raniganj area. Even though coal production had started in considerable quantities because of the great distances to which it had to be transported—Bombay, Madras, Karachi and other places—large quantities of coal from England and South Africa were still imported in the country by sea. The cost of transport proved too high, and even in the Calcutta market English coal was sold cheaper than domestic fuel. In order to meet foreign competition and to increase the consumption of Indian coal by other railways and by various mills and factories, the East Indian Railway reduced the rate for leads over 300 miles from 5·4 to 4·5 pies per ton mile. As the production of coal increased, leading simultaneously to an increase in the demand for Indian coal, and gradual

extinction of foreign imports, haulage rates continued to be progressively reduced by the railways. In 1905, telescopic rates were introduced, and the rate came down to 2·72 pies per ton mile. In 1889, the total coal traffic inclusive of foreign coal carried over the Indian Railways was 1,311,000 tons. In 1951-52, the total output of coal stood at 35,148,949 tons of which 32,761,000 tons were carried by rail, bringing to the railways a revenue of Rs 26·63 crores being over 9 per cent of the total income and 17·3 per cent of total freight earnings.

Cotton, jute, tea, sugar and coal are by no means the only industries which have expanded as a result of the introduction of railways. These examples are only illustrative of the manner in which railways have contributed to the building up of India's economy. In the distribution of foodgrains and other foodstuffs, in the carrying of ores and minerals, and in transporting the progressively increasing volume of exports and imports of several varieties, the railways have played an important part. Even during such national emergencies as war, famine and drought they have rendered signal service to the people.

POSTAL SERVICE

Railways were solely responsible for developing the cheap postal system as it exists today in the country. It is perhaps not generally realised that before railways started, regular mails were conveyed only over a very few main routes between important towns. Previous to 1854, the post office was a medley of separate services in different provinces, each having separate rules and different rates of postage. The cost of conveyance of a letter from Calcutta to Bombay was one rupee a tola (2/5 ounces), and from Calcutta to Agra twelve annas a tola. A letter ordinarily took eight to ten days from Calcutta to reach Bombay. Mail was carried by runners or couriers who journeyed on foot, on horses and camels, and by bullock carts, and horse carriages, and country boats. There was no regular system of carrying parcels.

With the introduction of railways, it became possible to carry mails to distant places safely and at short and regular intervals. As each line opened, it became the main channel of communication and mails were despatched for all post offices on the line, as also for places beyond the terminal point, from where they were carried by postal runners or by other means of conveyance.

Before 1863, mail bags were usually carried in the guard's van. Only when the mail was heavy, a separate compartment in the charge of a mail guard was used. Since no intermediate sorting was possible, every post office had to make up a packet or a bag for every other post office, and these packets were received and delivered at each station by the mail guard. In due course, the number of such packages became unmanageable and in order to make it possible to sort the mail, trains had to be detained at several intervening stations for long periods.

In 1870, a travelling post office was introduced on the East Indian Railway, but it was not till 1907 that the Railway Mail Service was established.

As the weight of mails to be carried increased, it was decided that two specially fitted compartments of a second class carriage should be set apart to serve as a travelling post office, on mail trains. Special vans were made available at extra haulage charge.

During recent years, air services have also been employed for carrying mails from one big city to another. Motor buses and steamers have been in use as means of supplementary transport. In the sandy tracks of Rajputana, camels are still to be found carrying mails. In certain parts, runners, horses, horse-drawn carriages and country boats are even now the most practicable means for carrying letters and parcels. But it is the railways which are the mainstay of the postal system. For carrying heavy mails and parcels, and for linking the postal system with the remotest parts of the country, the railways are, and will continue for many years to come, as the most important means of transport for the postal services.

XXIII. Since Independence

AUGUST 15, 1947 is a memorable date in the history of India. On this day India became independent. Certain areas were partitioned to create Pakistan. These changes had serious repercussions on Indian Railways. The war had already imposed a heavy strain on the transportation machine. It had left it in a state of serious deterioration. During the war, eight per cent of the metre gauge locomotives, fifteen per cent of the metre gauge wagons, nearly 4,000 miles of track, and four million sleepers had been sent abroad, particularly to the Middle East. There was inadequacy of power and rolling-stock and excessive accumulation of deferred maintenance, renewals and replacements, and serious depreciation of assets resulting from an intensive use of equipment. Indigenous capacity for repair and rehabilitation was extremely limited. Locomotives, machinery, tools and other equipment had to be obtained at greatly increased cost from foreign countries, which themselves were busily engaged in rehabilitation and reconversion to peace-time needs of their own.

INCREASED TRAFFIC

At the same time the volume of traffic, which the railways were obliged to move in 1947-48, showed unprecedented increase. Excluding the lines affected by partition, compared to 1938-39, the number of passengers originating during this year had risen from 355 million to 902 million, an increase of 154 per cent. The length of journeys performed by passengers showed an increase from 12,588 million passenger miles in 1938-39 to 29,013 million passenger miles, an increase of 130 per cent. The ton mileage of originating freight traffic showed an increase of 11 per cent. Against these, the total train mileage which railways were able to operate was only 134·7 million in 1947-48, as against 135·38 million in 1938-39. This naturally resulted in abnormal overcrowding in passenger trains, serious bottle-necks in transport, and delays and difficulties in the movement of goods.

PARTITION

The partition of the country brought with it fresh problems and new difficulties.

The two major systems—the Bengal Assam Railway on the eastern border, and the North Western Railway in the north-west—had to be divided between the two new Dominions. Exchanges of railway staff between one Dominion and the other seriously dislocated normal work. Some of the major workshops, bridge and track depots and stores, were suddenly lost to the two systems, without any alternate provision having been made. The situation was further aggravated by disturbances and large scale migration of refugees across the borders. The lines in Assam constituted into the Assam Railway, were cut off from the rest of the country. The construction of a railway link had to be undertaken immediately to provide a direct rail route to Assam over Indian territory. Partition also resulted in far-reaching changes in the pattern of traffic. The flow of traffic from and to northern India, which used to be routed to and from Karachi, had now to be diverted to Bombay, thus increasing heavily the load on the existing lines between Bombay and Delhi, even in excess of the capacity for which they were designed. Additional lines and yard facilities were required to be constructed as quickly as possible in order to augment existing capacity.

In pre-partition days, Pathankot was a terminus station for the broad gauge, and a starting station for narrow gauge Kangra Valley Railway. It served the requirements of Kulu, Dharamsala and Dalhousie and other hill stations in the area through road transport agencies. The direction of flow of traffic was mostly to and from Lahore which became part of Pakistan. The traffic needs of Jammu and Kashmir were met by rail heads, at Rawalpindi (in Pakistan) and Jammu, both directly connected with Lahore. With the partition of the country Jammu and Kashmir were deprived of these two routes and hence were cut off by land from the rest of India. A road from Pathankot to Jammu across the Ravi River was opened to traffic soon after partition, and Pathankot was expected to meet the additional demand of Jammu and Kashmir traffic. The direction of flow of traffic, instead of being from and to Lahore, as it was before partition, changed to and from Delhi, creating several problems requiring immediate attention.

MULTI-PURPOSE PROJECTS

Freedom naturally brought with it a fresh impetus to industries to expand production, involving the import of large quantities of heavy equipment. To eliminate shortages, foodgrains had to be moved more promptly from surplus to deficit regions. Large supplies of imported foodgrains had to be carried from sea ports to remote inland areas. Symbolic of the spirit of economic expansion and nation building were such schemes as Damodar Valley, the Bhakra Dam, the Tungabhadra Dam, the Hirakud and other multi-purpose hydro-electric and irrigation projects, requiring adequate provision by railways for the transport of heavy equipment, required for their construction.

The first to be tackled by the Indian Government Railways, naturally, was the inadequacy of power which was adversely reacting on railway working. During the war, the maintenance of locomotives had suffered severely on account of non-availability of spare parts. The small number of new locomotives received were totally inadequate to maintain the normal replacement programme. The position had deteriorated to such an extent that on 31st March 1949, nearly 30 per cent of the total locomotives of Indian Government Railways were over-age. Quite apart from the heavy expenditure on their maintenance and repairs, engine failures had become ominously frequent. Arrangements were made to place orders for 863 locomotives. The number has further been increased by subsequent orders placed abroad. In order to make railways self-sufficient in regard to broad gauge locomotives work on the Chittaranjan Locomotive Works was started in 1948 and completed on 1st November 1950.

The position with regard to wagons and passenger coaches was no better. The domestic capacity for producing new stock on replacement account was adversely affected by shortage of steel, and by limited indigenous capacity for production. The available passenger coaches were in a serious state of disrepair. Besides, they were far too few in number to cope with the post-war levels of passenger traffic, or even to relieve overcrowding. The capacity of railway workshops, the indigenous wagon manufacturers and the Hindustan Aircraft Manufacturing Factory, was pressed to the maximum to repair and renovate existing coaches and wagons, and to manufacture new ones of an improved pattern and better quality.

EMPLOYEES

The post-war problems relating to staff had to be dealt with. One of these was the large number of temporary employees. Before any definite policy could be applied, the opting of the staff on partition created a further complication. The absorption of these employees in permanent posts was taken up, and, out of the total number of temporary employees, 224,166 had been confirmed in permanent posts up to the end of March 1952. Steps were taken in respect of improving both conditions of work and wages. The Award of the Adjudicator, Mr Justice Rajadhyaksha, which was published in 1947 was accepted by Government in June 1948, in so far as it related to the hours of work, periodic rest and leave reserves, and a time limit of three years was given for implementing the same over the former nine Indian Government Railways. The implementation of the Award involved reduction in the hours of work, increase in the periodic rest and rate of overtime, and fixing of leave reserves, and the consequent employment of additional staff. The Adjudicator's recommendations in respect of hours of work and periodic rest, have been implemented over the former nine Indian Government Railways which

were parties to the dispute, and this has resulted in employment of more than fifty thousand persons on all the railways. Consequent on the integration of the ex-Indian states railways into the regrouped systems, the application of the Adjudicator's recommendations to the ex-States railway sectors of Indian Railways has been progressing. Over fifteen thousand displaced persons from Pakistan and a number of Indians returning from Burma on grounds of nationality have been absorbed in vacancies arising out of the implementation of the Adjudicator's Award.

At the same time, steps were taken to implement the recommendations of the Central Pay Commission so far as they applied to railway services. These recommendations created certain anomalies according to railway labour organisations, which required to be removed before implementation. A Joint Advisory Committee was set up in May 1949 consisting of four labour representatives, four representatives of the Railway Board and an independent Chairman. The amount of confidence and goodwill created by the recommendations of this Joint Advisory Committee among workers, can be judged from the views expressed by a leading member of the labour team in the Committee, who said that 'their task was a stupendous one' and that 'the achievement of this Committee is unprecedented.' Steps were immediately taken to implement the recommendations of the Committee. As a result of these steps the upgrading of posts and the weightage for service have resulted in substantial benefits to the staff. Leave rules have been liberalised, and the benefit of the State Railway Provident Fund has been extended to temporary staff who had completed one year's continuous service. The maintenance of grainshops at concessional rates has been continued. Cost price canteens giving cheap and wholesome food to staff have been provided at places where a considerable number of employees are concentrated *viz.* workshops, sheds, yards, large stations, running rooms, etc. The development of consumers cooperative stores on railways is also being encouraged.

Not only a large number of improved quarters have been constructed for railway workers, 6,825 alone were put up in 1951-52, but considerable funds have been spent to improve living conditions in the existing colonies as well. Facilities for training of the staff, and for the education of the children of the employees have been considerably enlarged and increased. Medical and health services have been strengthened, and steps have been taken in several other directions to provide increased social amenities and cultural opportunities to workmen. A significant index of the confidence and goodwill created by these steps is provided by the remarkable decline in the number of man-days lost on account of strikes from 0·2 per cent of the total number of man-days worked in 1948-49 to 0·013 per cent in 1951-52. This resulting goodwill and co-operation has naturally influenced staff

efficiency, enabling railways not only to cope successfully with the perplexing problems and difficulties which confronted them, but also to carry out large scale improvements.

REMOVING BOTTLE-NECKS

As a result of efforts to secure improved performance and increased efficiency in working, by 1949-50 it was possible for the railways to liquidate the various bottle-necks resulting from World War II, and events following August 1947. During this period ton mileage had increased by 36 per cent and passenger mileage by 161 per cent, as compared to 1938-39, which represented a considerable increase even on the figures for 1947-48. Train mileage has also shown an increase of 8·56 per cent. During this period, not only these additional burdens were borne successfully but in 1949, cent per cent transport was made available for both raw materials and finished products of certain basic industries, *i.e.* iron and steel, textiles, and cement, while at the same time giving foodgrains and coal high priority and special attention.

Certain special measures were improvised and instituted by the railways during this period to meet the situation. Special trains were operated towards the end of 1948 from certain stations to selected destinations, to afford a means of transporting expeditiously a variety of essential commodities such as salt, sugar, foodgrans, fodder, manganese ore, etc. In due course, the system, instead of being confined to wagon loads, was extended to the movement of ' smalls ' and non-priority goods from important centres. These trains were run on nominated dates, to schedule timings, assuring delivery at destination within a fixed time.

To relieve overcrowding of passengers the number of passenger trains was increased. Since overcrowding was greater in the lower classes, special express trains, called Janata Expresses for third class passengers only were introduced. By the end of 1952, Janata Expresses had been provided between Delhi and Pathankot on the ex-Eastern Punjab Railway (now Northern Railway), Delhi and Howrah on the ex-East Indian Railway (now running over the Northern and Eastern Railways), Lucknow and Katihar on the ex-Oudh and Tirhut Railway (now North Eastern Railway); and Madras (Central) and Mangalore/and Madras (Egmore) and Trichinopoly on the ex-South Indian Railway (now Southern Railway), and Bombay and Poona and Bombay and Madras on the Central Railway.

In 1946-47, only 54 per cent. of the broad gauge mail and express trains, and 43·2 per cent on the metre gauge did not lose time on the run. The delays in many cases were of several hours. By 1951-52, the percentage on the broad gauge had risen to 74 and on the metre gauge to 73. The general punctuality of all passenger trains improved from 67·6 per cent on broad gauge and 69·7 per cent on metre gauge in 1947-48, to 81·4 per cent and 76·7 per cent in 1949-50, respectively.

LOCOMOTIVES

The utilisation of locomotives, per locomotive on the line, also recorded a substantial improvement. The net ton mileage per engine hour increased from 1,755 in 1947-48, to 2,057 in 1951-52 on the broad gauge, and from 725 to 768 on the metre gauge. The average load hauled by an average train rose from 423 in 1947-48 to 487 in 1951-52, and for the metre gauge from 176 to 187. The utilisation of wagons improved during the same period from 34·3 to 40·9 wagon miles per wagon day on the broad gauge, and from 28·5 to 32·4 on the metre gauge. This operational efficiency and overall performance could hardly have been attained, but for the fact that by 1951-52 Indian Railways had succeeded in making good a large part of the deficiencies, while at the same time working hard towards planned expansion and improvement.

During this very period, steps were taken to link the Assam Railway with the rest of the Indian Railway system, and to provide an alternative access to Pathankot in view of the increased and altered flow of traffic, especially after the accession of Kashmir to India. The Assam Rail Link Project was taken up towards the end of January 1948. Its completion by early December 1949, in the face of formidable difficulties of a sub-montane region, thick forests, heavy rainfall and turbulent rivers, was a remarkable feat of engineering.

ASSAM RAIL LINK

The Assam Rail Link covers a distance of 143 miles. The route passes through thick malarial jungles which had to be cleared before surveys could be made, formation prepared, bridges built, track laid, and ancilliary services provided for train running. Between November 1948 and April 1949, two hundred million cubic feet of earth had to be moved for embankments and other earthwork to bring about an appropriate alignment. Between the two ends, the alluvial plains of East Bihar and West Assam, lay the foothills of the mighty Himalayas studded with boulders and shingle. The alignment interspersed with deep cuts and high fills cut across the drainage of the country and the problem lay in bridging 368 channels varying in size of bridge opening from 3 feet to 1,425 feet, spread over a distance of 250 miles. This had to be accomplished within one working season of five and a half months, in an area where rainfall usually exceeds 250 inches per year.

Including the Tista, Torsa and Sankosh, there are 22 rivers which required deep well foundations for constructing bridges. For other flood openings and hill streams, steel girder bridges on masonry abutments and piers were constructed. Heavy boulders up to six feet in diameter, and buried tree trunks were the usual obstacles encountered in well sinking. In this area the training of rivers on guide

bund principles had been rejected, as engineers had considered that the steep beds of rivers, high velocities of flood waters and presence of heavy flotsam rendered such methods unsuitable. The practice adopted instead was to bridge every river or stream, from bank to bank, and then protect the ends by spurs, etc, from year to year as found necessary. The adoption of bank-to-bank bridging on this project was, however, considered inordinately expensive and the training of rivers by guide bunds with certain modifications was adopted.

PRE-STRESSED CONCRETE GIRDERS

Steel girders of the Indian Railway Standard type and Army Standard Truss type were used for spans of bridges. In three bridges, however, pre-stressed concrete girders of 60 feet and 40 feet spans were cast *in situ*. These were cast and employed for the first time under railway loading in India and perhaps in the world, and this has been considered a remarkable and unique achievement in bridge building. In the case of one road under-bridge, a two-hinged rigid concrete frame of 44 feet span and 48° skew was built.

In all one span of 250 feet, 29 spans of 150 feet, 4 spans of 100 feet, 14 spans of 80 feet, 18 spans of 60 feet, 20 spans of 40 feet and 100 spans of 30 feet, and under were erected. Roofed area provided both for service buildings and residential accommodation is 550,000 square feet. The entire project was completed at a cost of Rs 8,89,71,204 being an average of Rs 6,22,176 per mile.

MUKERIAN PATHANKOT LINE

Work on the Mukerian-Pathankot line was started in November 1949, and the line was formally opened to traffic on 7th April 1952. The distance between Mukerian and Pathankot along the new line is just under 27 miles. The territory traversed is fertile and surplus in foodgrains, namely rice, wheat, maize, etc. It also abounds in citrus and mango fruits. The line cuts short the distance between Delhi and Pathankot (the gateway to the Kashmir and Kulu Valleys) by 44 miles. The project has cost Rs 3·77 crores mainly because of the heavy bridging involved on the section. Of the 132·14 feet of waterways per mile, nearly 82 feet is the contribution of the river Beas and another 13 feet of the Chakki. Beas and Chakki bridges alone account for nearly fifty per cent of the total expenditure. The total number of bridges built is 108, ranging from 18 inches diameter hume pipe culverts, to a single span of 350 feet clear across the Chakki River.

The construction required 35,000 tons of cement, 12,000 tons of steel girders and permanent way material, and 1,500,000 cubic feet of pitching stone, all carried from distant places to the site of the project. The total quantity of earth moved was 100,000,000 cubic feet and the total plinth area of all permanent buildings is 102,000 square feet.

KANDLA DEESA LINE

After the partition of India and the loss in consequence of the port of Karachi, the necessity for a major port on the west coast of India was keenly felt. Kandla, later named Gandhidham in Cutch, was considered a suitable site. In November 1949, the Government of India ordered the construction of a metre gauge line between Kandla and Deesa, the then existing terminus of the metre gauge railway, a distance of 170·04 miles. Work was commenced in January 1950, and the line was formally opened for traffic by the President of the Union on 2nd October 1952.

Part of the country traversed between Deesa and Varahi is flat and fertile. Between Adesar and Bhachau, the railway line passes through rocky undulating areas where a large number of bridges had to be built over several nullahs and rapids. Between Bhachau and Gandhidham the line gradually slopes down towards the sea. Banas River is the largest river crossed by the new railway. It has a catchment area of 1,264 square miles, most of which lies in the Aravalli hills. At the point where the railway line crosses the river (about two miles from Deesa) the river has a sandy bed, the bed slope being 5·62 feet in one mile. The maximum discharge of the river at this point is estimated at 240,000 cusecs. The bridge over the Banas River is the largest on the line consisting of 14 spans of 80 feet, plate girders, carried over mass concrete piers, and founded on single 22 feet diameter concrete wells.

Although on the Gandhidham-Deesa rail link steam locomotives are at present being employed, it is proposed eventually to use diesel locomotives as the 'hard water' available in the area traversed by the new rail link is unsuitable for feeding the boilers of steam locomotives.

These and several other measures required not only to restore the working of railways to a state of normality, but also to meet the expanding needs of a rapidly progressing country, naturally required considerable expenditure. Apart from large sums required for some of the non-recurring items of expenditure, on the recurring side, in 1950-51, as compared to pre-war figures, the wage bill alone had trebled. The cost of renewals and replacements had registered a similar increase. The charges of fuel had gone up by about 400 per cent. Railway earnings had also registered a steep and unprecedented rise, but could not always keep pace with expenditure. In 1949-50, working expenses had risen by 264 per cent as against an increase in the gross earnings of 190 per cent. The position improved in 1951-52 and the operating ratio was brought down as indicated in the financial figures referred to in a succeeding paragraph.

These figures are only indicative of the many complex financial problems which the railway administration had to encounter during this period of stress, strain and difficulty. The difficult ways and means position of the Government who act as bankers for the railways, during this period only added to the

perplexities of the railway administration. It was not possible during this period to withdraw such amounts as the railways considered necessary for the various items of expenditure from their reserve funds. In order to meet the increased cost of transportation, a modest increase in fares had to be made in April 1951.

REVISED RAILWAY CONVENTION

It was felt during this period that the Railway Convention of 1924 separating railway finance from general finance required urgent revision. The Convention of 1924 was adopted in order to ensure flexibility in the financial administration of railways as a commercial undertaking and to afford to them a measure of freedom to pursue a policy of expansion and development. The experience of twenty-five years after the adoption of the Convention showed that neither of these objectives had been realised. The contribution to the general revenues from railway surpluses was an indeterminate amount varying with the particular revenue surpluses of individual years. It could not, therefore, from the very nature of the case, assist in forward planning or in the framing of accurate civil estimates. It also denied railways opportunities of building up adequate reserves in the years of prosperity to ensure at least minimum returns to the general revenues in the years of depression. Thus in the mid-thirties, for example, net earnings had dropped to such low levels that it was not possible even to pay interest on capital. Not only was the Reserve Fund depleted, but serious inroads were made into the accumulations of the Depreciation Fund. The situation became so precarious that it was necessary to invoke the aid of a moratorium till, paradoxically enough, the calamity of war resulted in prosperity for the railways.

The provisions of the Convention had also led to other undesirable consequences. The rules of allocation of expenditure towards revenue and capital had adverse repercussions not only on railway finances generally, but also on the standard of amenities and the efficiency of the administration. The rules, for example, made it difficult to finance expenditure on passengers and staff amenities, because such expenditure was deemed unremunerative. Company-managed railways did not favour expenditure on projects which although not unremunerative were likely to reduce the overall yield on their capital. The acquisition of these railways by Government thus accentuated the problem of overtaking the bulk of neglected maintenance and lack of essential amenities both for the public and for the staff.

In 1949, a committee of Parliament was set up with wide terms of reference to review all the financial aspects and to recommend a new Convention. The recommendations of the Committee embodied in a resolution were accepted by Parliament in December 1949, and became operative with effect from 1st April 1950.

NEW FINANCIAL ARRANGEMENT

Under the new Convention the relationship between railway and general finance was altered to give the general taxpayer the status of the sole shareholder of the railway undertaking entitled to a guaranteed dividend of four per cent, as computed annually on the loaned capital invested by Government in the undertaking. The contribution to the Depreciation Fund was fixed at a minimum of Rs 15 crores a year, which amount was raised in 1950-51 to Rs 30 crores, thus permitting additional appropriations being made when railway surpluses permitted. The revised rules of allocation of expenditure between capital and revenue further sought to correct the over-capitalisation which was unavoidable in the earlier procedure. The full costs of replacement, including the improvement and inflationary elements, were henceforth to be charged to the Depreciation Fund. A development Fund was constituted with the balances of the Betterment Fund for the purpose of financing expenditure on passenger amenities, labour welfare, and projects deemed necessary and useful to the nation's economy, though unremunerative at the time of construction. Lastly, the Loan Account was separated from the Block Account, the former representing the capital at charge, and the latter the assets of the undertaking, whether financed from revenue or from loans.

The Convention was to hold good for five years. It represents an important step forward in the evolution of a progressive financial policy for railways. It has afforded the railways an opportunity for planning and executing a comprehensive programme of post-war development. The surpluses left after payment of the dividend on the capital have thus become available to them to be applied to strengthen the Reserve Fund, which in consequence would ensure adequate finances being available for expansion and developmental activities.

The effect of these changes may be studied in terms of the results of working of railways during the year 1951-52. The gross traffic receipts of the Indian Government railways were Rs 290·82 crores—the highest ever reached so far—representing an increase of 27·81 crores over the figures for 1950-51. Passenger earnings amounted to Rs 109·88 crores and goods earnings Rs 156·79 crores, the balance of Rs 24·15 crores being made up of other coaching and miscellaneous earnings. The working expenses amounted to Rs 194·04 crores, being 13·81 crores above the figure for the previous year. The appropriation to the Depreciation Fund was Rs 30·00 crores. The operating ratio thus was the lowest since 1947-48 being 77·00 per cent as against 79·9 per cent in 1950-51.

After meeting all charges, including the appropriation to the Depreciation Fund the net revenue on the results of working for the year amounted to Rs. 61·75 crores. Of this Rs 33·41 crores were paid to general revenues as dividend under

the revised Convention. The net surplus for the year amounted to Rs. 28·34 crores as against Rs 15·05 crores in 1950-51 and 14·59 crores in 1949-50. Of this Rs 10 crores were allocated to the Development Fund and Rs 18·34 crores to the Revenue Reserve.

THE CHANGE

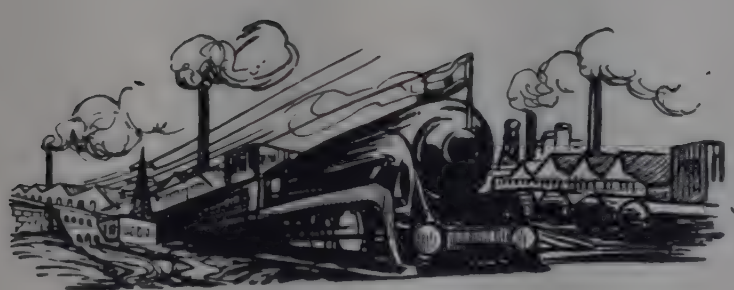
Besides meeting their own needs for rehabilitation, expansion and development, the railways, as the then Minister of Transport and Railways pointed out in 1951, 'have, in recent past, lent impressive support through the three earmarked fund balances to the general ways and means position of Government. That support expressed in terms of money, was of the order of Rs 121·71 crores at the end of 1948-49, and Rs 129·63 crores at the end of 1949-50.' Quite apart from this direct assistance to general finance, is the indirect help rendered by railways, by limiting their own demand on the balances of their reserve funds, so as not to curtail the resources of Government for national development activities in the realm of agriculture, industry, and other forms of transport. Railways have thus, speaking broadly, rendered an important service to the nation in sustaining current developmental programmes of the Government. Nothing can describe more picturesquely or summarise more appropriately, the spectacular achievements of the railways during this period of grand transition, than what the Prime Minister Shri Jawaharlal Nehru said at the inaugural ceremony of the Northern, North-Eastern and Eastern Railways in New Delhi on 14th April 1952. He said:—

> "I remember five years ago or about that time when the question of the then state of the Indian Railways came up repeatedly before us—before the Government, before the Cabinet. It was an obnoxious state, after the war, with our resources depleted, with all kinds of rolling stock and lines sent to Mesopotamia and other distant parts of the world, with no replenishments and no renewals, and with a terrific traffic. In fact, it was a painful experience not only to travel but to see other people travelling. It was hardly conceivable, and I would not have believed it if I had not seen it myself, how many people were jammed in into our third class compartments specially, and to some extent in the other classes also. So far as goods were concerned, I believe mountains of them piled up in our ports, and I remember in Bombay there was an astounding accumulation, and industries suffered, business suffered, everybody suffered ; it was a scandalous state of affairs that many people whose goods lay there had to pay some kind of demurrage, and yet they could not take them away.
>
> That was the state of affairs about five years ago. Soon after that, some months after that, came the partition, with all that that involved with that sudden overnight break-up of the railway system in the northern and north-eastern parts of India. That was a big blow—a big blow at a time when we were just staggering under the weight of the effects of the war. Immediately after the partition, in fact contemporaneously with it, came the huge migrations—those millions and millions

of refugees coming or going—either from Pakistan to India or from India to Pakistan : a tremendous thing ; and nobody who saw that migration either by train or by road or ot herwise can ever forget that astounding and ghastly picture. Trains not merely full inside, but full to the brim on the roof, on the foot-boards, everywhere—filled with suffering humanity. It was an awful sight.

All this burden fell on our railways just when they were least capable of carrying even their normal burdens. And yet we survived, and the railways survived. And one has only to see them now to see how they have risen and overcome all that multitude of difficulties—not only overcome those problems and difficulties, but built themselves anew—and are functioning now with a large measure of efficiency and punctuality. In the old days—I call them old days although it was only four or five years ago—trains were late by hours and hours, and nobody knew when they would arrive.

It is an astounding and astonishing change that has taken place and I think that we should not only take note of that change, and I hope even our worst critics will note that change—but also think of how that change has been brought about and on whom the burden of bringing about that change has lain . . . you can well presume the enormous amount of hard work and co-operative hard work that has gone into this business and I think we as a people, we as a Government have every reason to be proud of this work and to congratulate all those connected with our railways for what they have done.'



XXIV. Regrouping of Railways

THE REHABILITATION of a war-battered railway system, and rapid restoration of its operational efficiency to suit the needs of the nation's expanding economy, were not the only problems in the domain of railway transport which confronted the Government of the Union during the last six years. Due, however, to political conditions and financial exigencies, railway development in the past had been haphazard, and not always in accordance with the demands of maximum efficiency and minimum costs. To use the words of the late Shri Gopalaswami Ayyangar, 'During the last hundred years, railways in this country developed with no conscious design or settled pattern, resulting in diversity of practice, differences in the levels of efficiency in working, and standard of service to the public.' Under a multiple system of ownership and control, of state-owned and state-managed, state-owned and company-managed, and company-managed and company-owned railways along with lines run by Indian States directly or through companies, the railways were divided into a large number of big and small units, neither conducive to efficiency nor to economy. Even as recently as 1948, there were 42 railway systems consisting of 13 Class I Railways, 10 Class II Railways, and 19 Class III Railways. Among these were included 32 lines owned by ex-Indian States varying from 5 miles of the Sangli State to 1,396 miles of the Nizam's State, and having a total route mileage of 7,559.

WORLD TRENDS

The trend in other countries during the twentieth century and especially since World War I, had been towards greater unification, standardisation and enlargement of administrative zones. In Great Britain after World War I, twenty-seven constituent companies and near about a hundred other subsidiary lines had been regrouped into four main line systems. After World War II, by another Act of Parliament, transport was completely nationalised and Government acquired all the four railways. The trend was similar in France and Germany and even in Canada and the United States of America the movement towards integration has been gaining considerable support.

The idea of grouping the southern railways was conceived in 1904, but was not effectively pressed. It was not till after World War I that experts in India felt the need generally for regrouping of railways into larger and more viable units. The Acworth Committee first examined the question and suggested the grouping of Indian Railways into three territorial divisions. The western division was to consist of the Great Indian Peninsula, the Bombay, Baroda and Central India, the North Western, and Jodhpur-Bikaner together with the branch and feeder railways in their areas. The eastern division was to include the East Indian, Oudh and Rohilkund, Bengal and North Western, Rohilkund and Kumaon, Assam Bengal, Bengal Nagpur, and Eastern Bengal Railways together with ports and local railways. The southern railway was to be made up of the Madras and Southern Mahratta, South Indian, the Nizam's Railways together with ports and local railways.

These proposals were further considered by the Inchcape Committee (1922-23), which recommended that 'the preparation of a scheme of grouping the railways should be taken up forthwith.'

Speaking in the Legislative Assembly, on 26th February 1936, during the debate on the Railway Budget, the Railway Member accepted the proposals to amalgamate such lines as the Bombay, Baroda and Central India with the Great Indian Peninsula Railway and the Madras and Southern Mahratta with the South Indian Railway, as the basis of their future policy, but no steps towards its implementation were taken. Regrouping remained a consummation devoutly to be wished. Government felt confronted with some obvious difficulties, the most important being of multiple ownership and management.

STATE CONTROL

The first hurdle in this respect was removed in 1944 when all the former company-managed railways were taken over by the State. The division of the North Western and the Bengal Assam Railways on partition in 1947 left parts of these systems in India which called for a proper organisation for satisfactorily operating them. For the time being, however, these lines were reconstituted mostly into the Eastern Punjab Railway on the west and the Assam Railway in Assam. Without adequate workshop and other facilities, the two new systems were too small for efficient working and rendered the reorganisation of the railways in northern India imperative. With the administrative integration of the Indian States into the Union, the Government of India acquired control of all the railways except a very few privately-owned light railways. Opportunity was thus afforded to plan regrouping on comprehensive lines.

GROUPING

The Government came to the conclusion that some of the most difficult

problems of railway organisation and working could be tackled successfully only by consolidating the large number of small units into a small number of viable and efficient systems. Such a reorganisation, it was considered, would, besides bringing about reduction in the overheads as a result of the fusion of the higher administrative organisations of two or more railways into one, lead to elimination of duplication of work, unnecessary correspondence and inter-railway adjustments between numerous units, and, therefore, to more expeditious disposal of business. With the formation of larger units, the number of interchange junctions, transhipment points and the extent of dual control would be substantially reduced. The pooling of locomotives and rolling-stock in the larger jurisdiction of the new zones would afford more scope for intensive and balanced utilisation of power and equipment. These, along with other advantages, would contribute towards a considerable improvement in operational arrangements and result in larger economies. In pursuance of this policy, the Railway Board, in 1950, after careful consideration and study, prepared a plan of regrouping Indian Railways into six zonal systems, namely, the Northern, North Eastern, Eastern, Southern, Central and Western. The principles underlying the plan were to amalgamate the smaller independent lines in contiguous areas into self-sufficient systems in a compact region having economic unity and natural affinities of trade and flow of traffic, and in implementing it, to so phase the integration that there should be minimum dislocation in working, and no loss of operational efficiency. The plan as revised in the light of the views received from the State Governments, Chambers of Commerce, railway labour organizations and the public was approved by the Central Advisory Council for Railways in December 1950.

NEW ZONES

The first of the zones was formed on 14th April 1951, by the regrouping of the railway systems in South India and the inauguration at Madras of the Southern Railway. The Southern Zone consists of the Madras and Southern Mahratta, the South Indian, and the Mysore Railways.

Proceeding clockwise on the map of India, the regrouping of the next two zones resulting in the formation of the Central and Western Railways was completed on 5th November 1951. The Central Railway was formed by the amalgamation of the Great Indian Peninsula, the Nizam's State, the Scindia and the Dholpur Railway. The Western Railway was constituted by merging into the Bombay, Baroda and Central India Railway, the Saurashtra, the Rajasthan and Jaipur Railways.

The final phase of regrouping was completed on 14th April 1952, when the formation of the Northern, North Eastern, and Eastern Railways was inaugurated by the Prime Minister of India. The Northern Railway was made up of the

Eastern Punjab, the Jodhpur, the Bikaner and the three upper divisions of the East Indian Railway. The North Eastern Railway was a simple fusion of the Oudh and Tirhut and the Assam Railways. The Eastern Railway was constituted by amalgamating the remaining divisions of the East Indian Railway with the Bengal Nagpur Railway.

State ownership and control by the Railway Board had already facilitated this zonal regrouping by the introduction of such important measures as unified financial control, pooling of rolling-stock, running of through services and centralisation of the purchase of stores. The central authority had also promoted schemes for many years for the standardisation of locomotives, other rolling-stocks and spare parts. Steps had been taken to standardise passenger fares and to rationalise the freight rates system. The regrouping of the railways is thus in a sense the logical culmination of a process started many years ago.

BENEFITS OF REGROUPING

The advantages expected from the regrouping of the Indian Railways were summed up by the late Shri N. Gopalaswami Ayyangar in his speech on the inauguration of the Central and Western Railways:

> ' The present disparities in the standards of the smaller individual railways and their methods of working militate against rendering to the public as good a transportation service as they have a right to expect. Their consolidation . . . . will set forces at work which will, in due course, bring about improved standards and uniformity and up-to-dateness in methods of operation all round. The larger resources of each of the combined systems will enable local requirements to be met more satisfactorily and expeditiously. The effect of the regrouping on internal administration and operation will itself be of no small importance. The strength of a chain is determined by its weakest link. The disappearance of the smaller lines will remove the weak links of the present transport system. The reorganization of administration, the tightening up of control, the application of the increased resources of the enlarged system to the maximum advantage, the elimination of duplication and waste, the economies in the procurement, utilization and stocking of equipment and materials—all these, to mention only a few items, should help to reduce the overall cost of transportation both to the nation and to the individual. When it is realised that daily we in India carry only one-fifth of a ton mile per head of the population which is only one-sixth of the corresponding figures for Great Britain and as low as one-fiftieth of that for the United States, it will be appreciated how backward we are.'
>
> 'The Government stand committed to an economic programme of the immediate revitalisation of agriculture, rapid industrialization and the achievement of a reasonable standard of life by every man, woman and child. No such programme can be put through without an adequate recognition of its demands on rail transport. It necessarily would require an unprecedented increase in the freight tonnage to be hauled by railways, a pronounced acceleration of the speed and

> frequency of services and railway operation in general, at a high level of efficiency. Passenger traffic, both suburban and general, has been steadily growing and is bound to grow further still. It is my confident hope that the . . . new railways . . . will, in their organization, equipment and functioning adequately bear the increasing strains and stresses of expanding transportation in the areas they serve.'

On the occasion of the concluding phase of regrouping, the President of India, Shri Rajendra Prasad, in a message stated:

> 'I am glad that the process of reorganization of our railways which had been undertaken with a view to promote their efficient and economical working is going to be completed with the inauguration of the three remaining systems, *viz.*, the Northern Railway, the North Eastern Railway and the Eastern Railway. While time would show the full benefits of this reorganization, it is my hope that after its completion our Railways which are our most important nationalised industry would be able to look forward to an era of steady expansion and progress.'

It will take some time before the effects of regrouping can be fully assessed in terms of facts and figures. But within the brief period that the scheme has been in operation in different zones, the efficiency of railways has considerably increased and service to the public progressively improved.

XXV. Looking Ahead

THE INDIAN RAILWAYS today, to quote the words of the Prime Minister, Shri Jawaharlal Nehru, 'are our greatest, national asset. They are a State undertaking run by the State, controlled by the State, wholly managed through officers of the State—although naturally they form a separate department of the State.'* Whatever part they may have played in building up national economy in the past, in a free India, it is expected of them to play an even much greater part, and a much more vital part. The grouping of railways in six major systems, only marks the beginning of policies and measures designed to meet more adequately and efficiently the transport requirements of the country.

THE FIVE YEAR PLAN

India is in urgent need of increased production, improved standards of living for its people and augmentation of its national wealth. The draft Five Year Plan covering the period 1951-56, is an index of the sense of national urgency and the magnitude of the many problems of national reconstruction and development confronting the country. The success of this Plan in the field of agriculture, manufacturing industries, mining, development schemes, multipurpose projects, and the like, must to a considerable degree depend on the capacity of the railways to provide the transportation required.

A glance at the map of India will show that even after a century of railway development, there are vast regions in the country, inaccessible to rail communication, and hence inadequately equipped for proper economic development. The authors of the Five Year Plan have given great thought to these problems and included within its scope the plans for railway rehabilitation, and to a limited extent, for development.

REHABILITATION

The most serious problem facing the railways is still the task of rehabilitation

* Speech on the occasion of the inauguration of the Northern, North Eastern and Eastern Railways: 14th April 1952.

and making adequate provision for new equipment. The magnitude of the problem may be judged from the abnormal proportions of the over-age stock. The arrears of renewals accumulated by 31st March 1951 amounted to 1,050 locomotives, 5,514 coaching vehicles and 21,418 wagons, against the normal figures of average annual renewals of 190 locomotives, 650 coaching vehicles and 5,000 wagons. For an overall picture of the position during 1951-56, it is necessary to add to these figures the numbers which will become over-age during this period. The stock which will have reached the normal age of replacement by 31st March 1956, is 2,092 locomotives, 8,535 coaches and 47,533 wagons.

The state of stationary equipment is another subject of no less concern. The condition of the track has deteriorated during the last two decades, during which renewals were carried out only to the minimum extent required for safety in operation, leaving considerable rehabilitation of the track for completion in future.

ROLLING-STOCK

Various steps have been taken towards rehabilitation since 1947 and a planned programme has been outlined for the future. Apart from importing essential requirements from outside, arrangements are being accelerated to enable the country and the railways to become increasingly self-sufficient in respect of their requirements. Besides the Chittaranjan Locomotive Works, Government have also extended financial assistance to the Tata Locomotive Engineering Company by participating in its capital structure to the extent of two crores of rupees. While the production at Chittaranjan is expected to be 120 locomotives and 50 spare boilers per annum, about 200 locomotives are expected to be supplied by Tatas during the period of the Plan.

The indigenous production of coaches in 1948-49 was 238. In 1949-50, it was stepped up to 337 and in 1951-52 to 673. The estimated output of indigenous production during the period of the Plan is 4,380. To supplement existing indigenous production, work has already started on the establishment of a coach building factory at Perambur at an estimated cost of about four crores of rupees with an annual production capacity of 300-350 steel integral type coaches.

In 1948-49, indigenous production of wagons was 2,520, in 1949-50, 1,095 and in 1951-52, 3,707. Under the present arrangement it is estimated that 30,000 wagons will have been produced indigenously during the Plan period.

THE TRACK

The magnitude of the problems as regards the track can be gauged from the fact that at present speeds have been restricted over more than 2,000 miles of track on account of its weak condition. It is proposed to deal with 400 to 500 miles of track every year. As far as track renewals are concerned, maximum use

is proposed to be made of indigenous capacity for the production of track materials without importing in future any rails or sleepers from abroad. During 1949-50, Class I railways purchased locally 2·3 million wooden sleepers at a cost of Rs 3·90 crores. In addition, they purchased over 8 lakhs of cast iron and over 6 lakhs of steel sleepers. It is anticipated that purchases during the period of the Plan will be of the same order. In order to make maximum use of domestic resources proposals are under consideration for using half round sleepers for the metre gauge and narrow gauge lines, and to open more centres for the treatment of timber to prolong the life of sleepers. Provision has been made for the creation of two new depots for creosoting of timber at Clutterbuckganj and Coimbatore, in addition to those already in existence in Dhilwan in the Punjab and Naharkatiya in Assam.

During the last five years, special priority has been given by railways to provide improved amenities for passengers, particularly of the third class, and to add to their comfort and convenience in travel. In accordance with this policy a bulk provision of three crores of rupees has been made in the Five Year Plan to be spent annually for passenger amenity schemes.

GOODS TRAFFIC

The volume of goods traffic has been steadily on the increase and during the period of the plan with progressive industrialisation, and the development of major projects, a substantial increase over the present levels is anticipated. A significant example of the effect on rail transport of a new project is afforded by the Government Sindri Fertiliser Factory opened in 1951, for which the railways have to move daily about two thousand tons of gypsum, from Rajasthan to the site of the factory in Bihar. The installation of the proposed oil refineries in the island of Trombay near Bombay will require by 1955 the services of nearly 250 wagons and tank wagons every day, for the movement of finished products from the refineries when they are in operation. The execution of other major development projects in the near future will similarly impose heavy additional demand on the transport system. Production has been on the increase in many fields of industry such as coal, sugar and jute. The transport of raw materials required by these, and other industries, and of their finished products, also represents a substantial increase in transportation requirements. Provision has been made by the railways in the Five Year Plan to meet these increasing needs and to remove bottle-necks.

In order to overtake the accumulated arrears of maintenance and rehabilitation and to provide for an immediate programme of development for meeting the increasing obligations of the railways as a public utility concern, the railway Plan for the five year period contemplates an expenditure of Rs 80 crores a year, or

Rs 400 crores in the aggregate. Provision has also been made for opening new lines at an expense of Rs 20 crores. Three hundred and twenty crores out of this aggregate of Rs 400 crores will be raised by the railways from their own resources and Rs 80 crores will be provided as a contribution from the Central revenues. Stated on an annual basis, against the contribution of Rs 16 crores a year from the Central revenues, the railways will be expected to find from their current revenues on an average Rs 64 crores a year.

During the year 1952-53, several steps were taken towards implementation of the various proposals adumbrated in the Five Year Plan and a detailed scheme of further steps proposed to be taken during 1953-54 in the same direction was outlined by the Minister for Railways, Shri Lal Bahadur Shastri, in his speech in Parliament on 18th February 1953, while introducing the Railway Budget for the ensuing year.

ADDITIONAL LINES

Of the twelve lines dismantled during war time, restoration of which was approved by the Central Board of Transport in 1950, two have already been completed, two more will be restored in the present year, seven are nearing completion, while the remaining one, *i.e.,* Rohtak-Gohana-Panipat line on the Northern Railway will be taken up during 1953-54, for which a provision of Rs 22 lakhs has been made. During 1953-54, work on 267 miles of new lines is proposed to be taken up for which a provision has been made for Rs 12·79 crores. The most important of them are the Khandwa-Hingoli Link, 186 miles in length, and the 31-mile line connecting Gua-Barabil with Manoharpur-Rourkela section necessitated by the export of iron ore for the purposes of expansion of steel production. The survey of Bhavnagar-Tarapur line in Saurashtra, and reconnaissance surveys of a broad gauge line in Indore, in Madhya Bharat, and between Barabil and Sambalpur in Orissa were taken in hand in 1952-53 and are nearing completion. In addition, surveys of seven other projects are to be undertaken in 1953-54; these being the Diva-Dasgaon line in Bombay, electrification of Calcutta suburban section in West Bengal, the Mangalore-Hassan line in Madras and Mysore, Rail connection to Etah in Uttar Pradesh and to Chandigarh in the Punjab, the Tildanga-Khajuria-Malda line in West Bengal and the Fatehpur-Churu line in Rajasthan.

GANGA BRIDGE

Work on the construction of the rail-cum-road bridge over the Ganga near Mokameh, which was suspended some time ago owing to differences of opinion regarding the site of the bridge, has now been taken in hand. When completed this bridge is expected to provide a much needed rail link across the Ganga.

It is proposed to spend a sum of four crores of rupees for the removal of bottle-necks in respect of the movement of traffic between, for example, Bezwada and Madras, the transhipment difficulties of some of the break of gauge junctions like Sabarmati, or some of the other sections requiring facilities for increased movement of coal, iron and steel.

By running additional trains and by increasing the lead of existing trains, the railways expect not only to relieve overcrowding but also to provide for greater convenience to passengers. Between 1st April 1952 and 1st January 1953, 109 new trains were introduced and the runs of 108 trains extended, involving a net increase in the daily passenger train miles of 9,850.

AMENITIES

In respect of removing 'the discomforts of third class passengers' and improving the conditions at small stations lacking even in the minimum of facilities,' the Minister for Railways made an important pronouncement in his Budget speech on 18th February 1953. He said:

> 'Certain minimum amenities like waiting halls, benches, drinking water supply, improved platform surfacing, better booking arrangements, etc, will be gradually provided at all stations irrespective of their size and status. At the more important stations, improved lighting arrangements, coverings over passenger platforms and improved arrangements for dealing with luggage, etc, are proposed to be provided.'

PUBLIC OPINION

In order to afford frequent opportunities for closer consultation between railway users and the railway administrations at different levels on matters relating to the service provided by the railway it has been decided to establish, in place of the existing advisory committees:

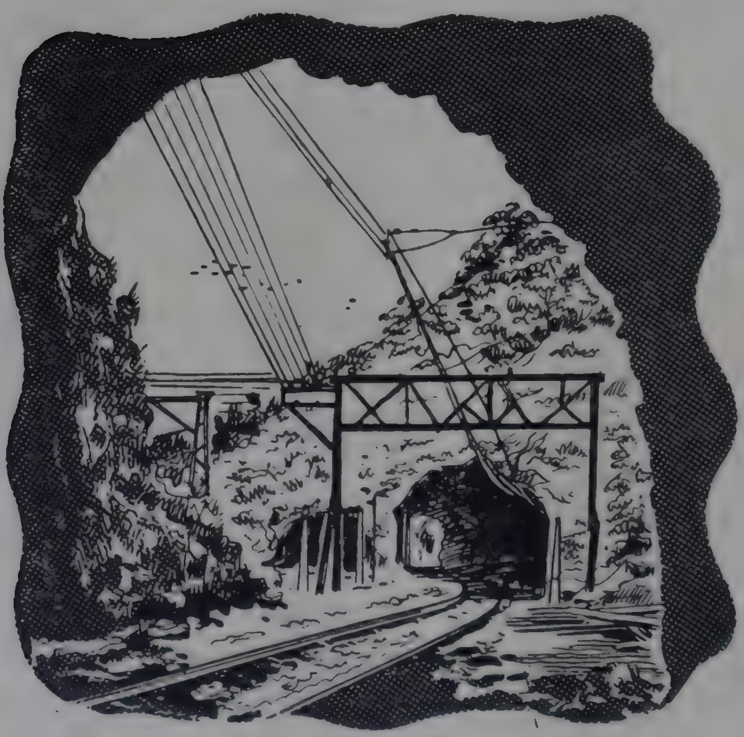
1. Railway Users' Consultative Committees at the regional or divisional levels;
2. a Zonal Railway Users' Consultative Committee at the headquarters of each railway; and
3. a National Railway Users' Consultative Council at the centre. The Railway Users' Consultative Committees in the regions or divisions will represent the local users in the territories served by the railways including agricultural interests. The National Railway Users' Consultative Council at the centre will deal with matters of all-India importance relating to the services and facilities provided by the railways, while the zonal committees would deal with similar matters in regard to the respective zones.

RAILWAYS AND THE NATION

During the last hundred years, railways have played a vital part in the progress and development of the country. Limitations on their ability to offer greater service than they have rendered, may have been imposed by natural obstacles, or by political and economic factors, but they have all along maintained a standard of efficiency of which any country and any service can be proud.

The importance of the successful working of the Indian Railways to the economy of the country was appropriately referred to by the Prime Minister, Shri Jawaharlal Nehru, in his message on the inauguration of the Central and Western Railways:

> 'The Railways are and will continue to be our greatest national undertaking. They deal intimately with scores of millions of people in the country and have to look after their comfort and convenience. They deal also with a very large number of employees whose welfare should always be their concern. A great national and state-owned organisation, like the Railways, is not only an asset of importance but is also a great responsibility. It can only be run with the fullest cooperation of all those engaged in it, keeping in view always the good of the public as well as the good of those engaged in serving the public through this vast organisation.'



APPENDIX A

Railway Administrations in India on 31st March 1948

Alphabetically arranged by classes according to their gross earnings showing working agencies, ownership and route mileage

Indian Railway systems have been classified under three classes for statistical purposes—

CLASS I RAILWAYS with gross earnings of Rs 50 lakhs and over a year ;

CLASS II RAILWAYS with gross earnings of less than Rs 50 lakhs a year, but exceeding Rs 10 lakhs a year ;

CLASS III RAILWAYS with gross earnings of Rs 10 lakhs and under a year.

Railway	Gauge	Route Mileage	Owned by	Worked by
CLASS I RAILWAYS				
1. *Assam*				
(*a*) Assam	3′ 3⅜″	1,131	Indian Government	Indian Government.
(*b*) Chaparmukh-Silghat*	3′ 3⅜″	51	Branch Line Company	,,
(*c*) Katakhal-Lalabazar*	3′ 3⅜″	24	,,	,,
(*d*) Cooch-Behar State	3′ 3⅜″	33	Indian State	,,
2. *Bengal Nagpur*				
(*a*) Bengal Nagpur	5′ 6″	2,463	Indian Government	,,
(*b*) Mayurbhanj	2′ 6″	71	Branch Lines Company†	,,
(*c*) Parlakimedi Light	2′ 6″	56	Private body	,,
(*d*) Purulia-Ranchi	2′ 6″	117	Indian Government	,,
(*e*) Raipur-Dhamtari	2′ 6″	55	,,	,,
(*f*) Satpura	2′ 6″	626	,,	,,
3. *Bikaner State*				
(*a*) Bikaner State	3′ 3⅜″	876	Indian State	Indian State
(*b*) Nabha Section of the Sadulpur-Rewari Line	3′ 3⅜″	7	,,	,,

* This line is guaranteed by the Government of India and also receives a subsidy from the Assam Government.

† Under rebate terms.

Railway	Gauge	Route Mileage	Owned by	Worked by
CLASS I RAILWAYS—(*contd.*)				
4. *Bombay, Baroda and Central India*				
(*a*) Bomby, Baroda and Central India	5′ 6″ 3′ 3⅜″	1,198 1,968	Indian Government "	Indian Government
(*b*) Nagda-Ujjain	5′ 6″	35	Indian State	"
(*c*) Gaekwar's Petlad Cambay (Anand-Tarapur Section)	5′ 6″	21	"	"
(*d*) Gaekwar's Petlad-Cambay (Tarapur-Cambay Section)	5′ 6″	12	"	"
(*e*) Palanpur State	3′ 3⅜″	17	"	"
(*f*) Champaner Shivrajpur-Pani Light	2′ 6″	31	Indian Government	"
(*g*) Godhra Lunavada	2′ 6″	26	"	"
(*h*) Nadiad Kapadvanj	2′ 6″	28	"	"
(*i*) Rajpipla State	2′ 6″	58	Indian State	"
(*j*) Piplod-Devgad Baria	2′ 6″	10	"	"
5. *East Indian*				
(*a*) East Indian	5′ 6″	4,358	Indian Government	Indian Government
(*b*) Kanpur-Bara Banki and others	3′ 3⅜″	·4	"	"
(*c*) Santipur-Nabadwip	2′ 6″	17	"	"
6. *Eastern Punjab*				
(*a*) Eastern Punjab	5′ 6″	1,484	"	"
(*b*) Ludhiana-Dhuri-Jakhal	5′ 6″	79	Indian State	"
(*c*) Rajpura-Bhatinda	5′ 6″	108	"	"
(*d*) Jind-Panipat	5′ 6″	26	"	"
(*e*) Sirhind-Rupar	5′ 6″	31	"	"
(*f*) Rupar-Talaura*	5′ 6″	22	Indian Government	"
(*g*) Kalka-Simla	2′ 6″	60	"	"
(*h*) Kangra Valley†	2′ 6″	68	"	"

* Jointly owned by the Government of India and Provincial Government.
† Guaranteed by Provincial Government.

Railway	Gauge	Route Mileage	Owned by	Worked by
CLASS I RAILWAYS—(*contd.*)				
7. *Great Indian Peninsula*				
(*a*) Great Indian Peninsula	5′ 6″	3,041	Indian Government	Indian Government.
(*b*) Bhopal-Itarsi	5′ 6″	57	Indian State*	,,
(*c*) Bhopal-Ujjain	5′ 6″	115	Indian State	,,
(*d*) Bina-Baran	5′ 6″	147	,,	,,
(*e*) Dhond-Baramati	2′ 6″	27	Indian Government	,,
(*f*) Ellichpur-Yeotmal	2′ 6″	118	Branch Line Company†	,,
(*g*) Pachora-Jamner	2′ 6″	35	,,	,,
(*h*) Pulgaon-Arvi	2′ 6″	22	,,	,,
8. *Jodhpur*				
(*a*) Jodhpur	3′ 3⅜″	807	Indian State	Indian State.
(*b*) Jodhpur-Hyderabad (Pakistan Section)	3′ 3⅜″	319	Foreign (Pakistan)	,,
9. *Madras and Southern Mahratta*				
(*a*) Madras and Southern Mahratta	5′ 6″ 3′ 3⅜″	1,091 1,712	Indian Government ,,	Indian Government.
(*b*) Kolar Gold fields (M.S.) Railway	5′ 6″	10	Indian State	,,
(*c*) Tenali-Repalle	5′ 6″	21	District Board	,,
(*d*) Alnavar-Dandeli (Provincial)	3′ 3⅜″	19	Indian Government	,,
(*e*) Kolhapur State	3′ 3⅜″	29	Indian State	,,
(*f*) Sangli State	3′ 3⅜″	5	,,	,,
(*g*) West of India Portuguese	3′ 3⅜″	51	Foreign Country	,,
10. *Mysore State*				
(*a*) Mysore State	3′ 3⅜″	609	Indian State	Indian State.
(*b*) Bangalore-Chik Ballapur Light	2′ 6″	39	,,	,,
(*c*) Kolar District‡	2′ 6″	64	,,	,,

* Jointly owned by the Government of India and the Indian State.

† Under Rebate terms.

‡ Jointly owned by the Mysore Government and Kolar District Board, and Guaranteed by the Mysor Government for the District Board.

Railway	Gauge	Route Mileage	Owned by	Worked by
CLASS I RAILWAYS—(*concld.*)				
10. *Mysore State*—(concld.)				
(*d*) Tarikere-Narasimharaja-pura Tramway	2′ 0″	27	Indian State	Indian State.
11. *Nizam's State*				
(*a*) Nizam's State	5′ 6″	667*	,,	,,
	3′ 3⅜″	659†	,,	,,
(*b*) Bezwada Extension	5′ 6″	22	Indian Government	,,
(*c*) Dronachellam-Kurnool	3′ 3⅜″	36	,,	,,
12. *Oudh Tirhut*‡	3′ 3⅜″	3,073	,,	Indian Government.
13. *South Indian*				
(*a*) South Indian	5′ 6″	559	,,	,,
	3′ 3⅜″	1,479	,,	,,
(*b*) Shoranur-Cochin	5′ 6″	69	Indian State	,,
(*c*) Cochin Harbour	5′ 6″	4	Unassisted Company	,,
(*d*) Nilgiri	3′ 3⅜″	29	Indian Government	,,
(*e*) Peralam-Karaikkal	3′ 3⅜″	15	Foreign Country	
(*f*) Pondicherry	3′ 3⅜″	8	,,	
(*g*) Tinnevelly-Tiruchendur	3′ 3⅜″	38	District Board	,,
(*h*) Travancore (Indian Government Section)	3′ 3⅜″	51	Indian Government	,,
(*i*) Travancore (Indian State Section) including Quilon Trivandrum Central Extension	3′ 3⅜″	98	Jointly owned by Indian Government and Travancore Durbar (Indian State)	,
TOTAL—CLASS I RAILWAYS		30,341		

* Includes Kazipet Balharshah, Karepalli Kothagudium, and Vikarabad Bidar and extension Branches.

† Comprises of Hingoli Branch, Hyderabad-Godavery Valley, Parbhani-Purli, Secunderabad-Indian Frontier, Jankampet-Bodhan and Mudkhed-Himayatnagar Branches.

‡ Comprises of B. & N. W. Zone, R. and K. Zone, Mashrak Thawe, Tirhut, and B. A. Zone, etc.

Railway	Gauge	Route Mileage	Owned by	Worked by
CLASS II RAILWAYS				
1. *Barsi Light*	2′ 6″	203	Unassisted Company	Barsi Light Railway Co.
2. *Bhavnagar State*	3′ 3⅜″	307	Indian State	Indian State.
3. *Darjeeling Himalayan*				
(*a*) Darjeeling Himalayan	2′ 0″	51	Subsidised*	Darjeeling-Himalayan Railway Co.
(*b*) Darjeeling-Himalayan Extension	2′ 0″	95	Branch Line Company†	,,
4. *Gaekwar's Baroda State*				
(*a*) Gaekwar's Baroda State	3′ 3⅜″ 2′ 6″	308 405	Indian State ,,	Indian State. ,,
(*b*) Beodeli Chhota Udaipur	2′ 6″	23	,,	,,
5. *Gondal*	3′ 3⅜″	213	,,	,,
6. *Jaipur State*	3′ 3⅜″	253	,,	,,
7. *Jamnagar and Dwarka*	3′ 3⅜″	212	,,	,,
8. *Junagadh State*	3′ 3⅜″	229	,,	,,
9. *Morvi*	3′ 3⅜″	173	,,	,,
10. *Shahdara (Delhi) Saharanpur Light*	2′ 6″	93	Company subsidised‡	Shahdara (Delhi) Saharanpur Light Railway Co.
TOTAL—CLASS II RAILWAYS		2,565		

* By the local Government.
† Under Rebate terms.
‡ Receives land only from the Government.

Railway	Gauge	Route Mileage	Owned by	Worked by
CLASS III RAILWAYS				
1. *Ahmadpur Katwa*	2′ 6″	32	Branch Line Company*	Ahmadpur-Katwa Railway Co.
2. *Arrah Sasaram Light*	2′ 6″	65	Company subsidised†	Arrah Sasaram Light Railway Co.
3. *Bankura Damodar River*	2′ 6″	60	Branch Line Company*	Bankura-Damodar River Railway Co.
4. *Baraset Basirhat Light*	2′ 6″	52	Company subsidised†	Baraset-Basirhat Light Railway Co.
5. *Bengal Provincial*				
(*a*) Bengal Provincial	2′ 6″	33	Unassisted Company	Bengal Provincial Railway Co.
(*b*) Dasghara-Jamalpurganj	2′ 6″	8	Branch Line Company*	,,
6. *Bukhtiarpur Bihar Light*	2′ 6″	33	Company subsidised†	Bukhtiarpur-Bihar Light Railway Co.
7. *Burdwan Katwa*	2′ 6″	32	Branch Line Company*	Burdwan Katwa Railway Co.
8. *Cutch State*	2′ 6″	72	Indian State	Indian State.
9. *Dehri Rohtas Light*	2′ 6″	24	Company subsidised†	Dehri-Rohtas Light Railway Co.
10. *Dholpur State*	2′ 6″	55	Indian State	Indian State.
11. *Futwa Islampur*	2′ 6″	27	Branch Line Company*	Futwah-Islampur Light Railway Co.
12. *Howrah Amta Light*	2′ 0″	44	Company subsidised†	Howrah-Amta Light Railway Co.

* Guaranteed by the Government of India.

† By the District Board.

Railway	Gauge	Route Mileage	Owned by	Worked by
CLASS III RAILWAYS—(*concld.*)				
13. *Howrah Sheakhala Light*	2′ 0″	20	Company subsidised †	Howrah-Sheakhala Light Railway Co.
14. *Jagadhri Light*	2′ 0″	3	Unassisted Company	Jagadhri Light Railway Co.
15. *Kalighat Falta*	2′ 6″	26	Branch Line Company*	Kalighat Falta Railway Co.
16. *Matheran (Hill) Light*	2′ 0″	13	Company subsidised‡	Matheran (Hill) Light Railway Company.
17. *Mewar State*	3′ 3⅜″	163	Indian State	Indian State.
18. *Scindia State*	2′ 0″	294	,,	,,
19. *Tezpore-Balipara Light*	2′ 6″	20	Company subsidised†	Tezpore-Balipara Light Railway Co.
TOTAL—CLASS III RAILWAYS		1,079		

* Guaranteed by the Government of India.

† By the District Board.

‡ By the Government of India ; subsidy ceased with effect from 1914-15.

APPENDIX B

Railway Administrations in India on 16th April 1953

Alphabetically arranged by classes according to their gross earnings showing the working agencies, ownership and route mileage

Indian Railway systems have been classified under three classes for statistical purposes—

CLASS I RAILWAYS with gross earnings of Rs 50 lakhs and over a year ;

CLASS II RAILWAYS with gross earnings of less than Rs 50 lakhs a year but exceeding Rs 10 lakhs a year ;

CLASS III RAILWAYS with gross earnings of Rs 10 lakhs and under a year.

Railway	Gauge	Route Mileage	Owned by	Worked by
CLASS I RAILWAYS				
I. *Central*				
(*a*) Central	5′ 6″	4,091	Indian Government	Indian Government.
	3′ 3⅜″	773	„	„
	2′ 6″	117	„	„
	2′ 0″	307	„	„
(*b*) Ellichpur-Yeotmal	2′ 6″	118	Branch Line Company*	„
(*c*) Pulgaon-Arvi	2′ 6″	22	„	„
2. *Eastern*				
Eastern	5′ 6″	4,733	Indian Government	„
	2′ 6″	942	„	„
3. *North Eastern*				
(*a*) North Eastern	5′ 6″	2†	„	„
	3′ 3⅜″	4,655	„	„
	2′ 0″	72	„	„
(*b*) Chaparmukh-Silghat	3′ 3⅜″	51	Branch Line Company‡	„
(*c*) Katakhal-Lalabazar	3′ 3⅜″	23	„	„
4. *Northern*				
(*a*) Northern	5′ 6″	3,870	Indian Government	„
	3′ 3⅜″	1,997	„	„
	2′ 6″	128	„	„
(*b*) Rupar-Nangal Dam§	5′ 6″	34	„	„

*Under Rebate terms.

†This line is between Haldibari and Pakistan Border for direct communication with Pakistan.

‡This line is guaranteed by the Government of India and receives a subsidy from the Assam Government.

§Jointly owned by the Government of India and the Government of the Punjab.

Railway	Gauge	Route Mileage	Owned by	Worked by
CLASS I RAILWAYS—(*concld.*)				
5. *Southern*				
(*a*) Southern	5′ 6″ 3′ 3⅜″ 2′ 6″	1,729 4,006 102	Indian Government " "	Indian Government. "
(*b*) Tenali-Repalle	5′ 6″	22	District Board, Guntur	"
(*c*) Cochin Harbour Extension	5′ 6″	4	Cochin Harbour Authority	"
(*d*) Alnavar-Dandeli (Provincial)	3′ 3⅜″	19	Government of Bombay	"
(*e*) West of India Portuguese	3′ 3⅜″	51	West of India Portuguese Railway Co.	"
(*f*) Peralam-Karaikkal	3′ 3⅜″	15	French Government	"
(*g*) Pondicherry	3′ 3⅜″	8	Pondicherry Railway Co.	"
(*h*) Tinnevelly-Tiruchendur	3′ 3⅜″	38	District Board, Tinnevelly	"
(*i*) Nanjangud Town Chamarajanagar	3′ 3⅜″	22	District Boards, Mysore and Mandya	"
6. *Western*				
Western	5′ 6″ 3′ 3⅜″ 2′ 6″	1,266 3,573 792	Indian Government " "	Indian Government. "
TOTAL—CLASS I RAILWAYS		33,582		
CLASS II RAILWAYS				
1. *Barsi Light*	2′ 6″	203	Unassisted Company	Barsi Light Railway Co.
2. *Shahdara (Delhi) Saharanpur Light*	2′ 6″	93	Company subsidised*	Shahdara (Delhi) Saharanpur Light Railway Co.
TOTAL—CLASS II RAILWAYS		296		

* Receives land only from the Government.

Railway	Gauge	Route Mileage	Owned by	Worked by
CLASS III RAILWAYS				
1. *Ahmadpur Katwa*	2′ 6″	32	Branch Line Company*	Ahmadpur-Katwa Railway Co.
2. *Arrah Sasaram Light*	2′ 6″	65	Company subsidised†	Arrah-Sasaram Light Railway Co.
3. *Bankura Damodar River*	2′ 6″	60	Branch Line Company*	Bankura-Damodar River Railway Co.
4. *Baraset Basirhat Light*	2′ 6″	52	Company subsidised†	Baraset-Basirhat Light Railway Co.
5. *Bengal Provincial*				
(*a*) Bengal Provincial .	2′ 6″	33	Unassisted Company	Bengal Provincial Railway Co.
(*b*) Dasghara-Jamalpurganj	2′ 6″	9	Branch Line Company*	,,
6. *Bukhtiarpur Bihar Light*	2′ 6″	33	District Board, Patna	District Board, Patna.
7. *Burdwan Katwa*	2′ 6″	33	Branch Line Company*	Burdwan-Katwa Railway Co.
8. *Dehri Rohtas Light*	2′ 6″	24	Company subsidised†	Dehri-Rohtas Light Railway Co.
9. *Futwah Islampur*	2′ 6″	27	Branch Line Company*	Futwah-Islampur Light Railway Co.
10. *Howrah Amta Light*	2′ 0″	44	Company subsidised†	Howrah-Amta Light Railway Co.

* Guaranteed by the Government of India.

† By the District Board.

Railway	Gauge	Route Mileage	Owned by	Worked by
CLASS III RAILWAYS—(*concld.*)				
11. *Howrah Sheakhala Light*	2′ 0″	20	Company subsidised*	Howrah-Sheakhala Light Railway Co.
12. *Jagadhri Light*	2′ 0″	3	Unassisted Company	Jagadhri Light Railway Co.
13. *Kalighat Falta*	2′ 6″	26	Branch Line Company†	Kalighat Falta Railway Co.
TOTAL—CLASS III RAILWAYS		461		

* By District Boards.

† Guaranteed by the Government of India.

APPENDIX C

Resolution regarding the separation of Railway from General Finances

Adopted by the Legislative Assembly on 20th September 1924, and the Resolutions of 1943 and 1949

'This Assembly recommends to the Governor General in Council that in order to relieve the general budget from the violent fluctuations caused by the incorporation therein of the railway estimates and to enable railways to carry out a continuous railway policy based on the necessity of making a definite return to general revenues on the money expended by the State on Railways;

(1) The railway finances shall be separated from the general finances of the country and the general revenues shall receive a definite annual contribution from railways which shall be the first charge on the net receipts of railways:

(2) The contribution shall be based on the capital at charge and working results of commercial lines, and shall be a sum equal to one per cent on the capital at charge of commercial lines (excluding capital contributed by companies and Indian States) at the end of the penultimate financial year *plus* one-fifth of any surplus profits remaining after payment of this fixed return, subject to the condition that, if in any year railway revenues are insufficient to provide the percentage of one per cent on the capital at charge surplus profits in the next or subsequent years will not be deemed to have accrued for purposes of division until such deficiency has been made good.

The interest on the capital at charge of, and the loss in working, strategic lines shall be borne by general revenues and shall consequently be deducted from the contribution so calculated in order to arrive at the net amount payable from railway to general revenues each year.

(3) Any surplus remaining after this payment to general revenues shall be transferred to a railway reserve; provided that if the amount available for transfer to the railway reserve exceeds in any year three crores of rupees only two-thirds of the excess over three crores shall be transferred to the railway reserve and the remaining one-third shall accrue to general revenues.

(4) The railway reserve shall be used to secure the payment of the annual contribution to general revenues; to provide, if necessary, for arrears of depreciation and for writing down and writing off capital; and to strengthen the financial position of railways in order that the services rendered to the public may be improved and rates may be reduced.

(5) The railway administration shall be entitled, subject to such conditions, as may be prescribed by the Government of India, to borrow temporarily from the capital or from the reserves for the purpose of meeting expenditure for which there is no provision or insufficient provision in the revenue budget subject to the obligation to make repayment of such borrowings out of the revenue budgets of subsequent years.

(6) A Standing Finance Committee for Railways shall be constituted consisting of one nominated official member of the Legislative Assembly who should be chairman and eleven members elected by the Legislative Assembly from their body. The members of the Standing Finance Committee for Railways shall be *ex-officio* members of the Central Advisory Council, which shall consist, in addition, of not more than one further nominated official member, six non-official members selected from a panel of eight elected by the Council of State from their body and six non-official members selected from a panel of eight elected by the Legislative Assembly from their body.

The Railway Department shall place the estimate of railway expenditure before the Standing Finance Committee for Railways on some date prior to the date for the discussion of the demand for grants for railways and shall, as far as possible, instead of the expenditure programme revenue show the expenditure under a depreciation fund created as per the new rules for charge to capital and revenue.

(7) The railway budget shall be presented to the Legislative Assembly, if possible, in advance of the general budget and separate days shall be allotted for its discussion, and the Member in charge of Railways shall then make a general statement on railway accounts and working. The expenditure proposed in the railway budget, including expenditure from the depreciation fund and the railway reserve, shall be placed before the Legislative Assembly in the form of demands for grants. The form the budget shall take after separation, the detail it shall give and the number of demands for grants into which the total vote shall be divided shall be considered by the Railway Board in consultation with the proposed Standing Finance Committee for Railways with a view to the introduction of improvements in time for the next budget, if possible.

(8) These arrangements shall be subjected to periodic revision but shall be provisionally tried for at least three years.

(9) In view of the fact that the Assembly adheres to the resolutions passed in February 1923, in favour of State management of Indian Railways, these arrangements shall hold good only so long as the East Indian Railway and the Great Indian Peninsula Railway and existing State-managed railways remain under State management. But if in spite of the Assembly's resolution above referred to Government should enter on any negotiations for the transfer of any of the above railways to Company management such negotiations shall not be concluded until facilities have been given for a discussion of the whole matter in the Assembly. If any contract for the transfer of any of the above railway to company management is concluded against the advice of the Assembly, the Assembly will be at liberty to terminate the arrangements in this Resolution.

Apart from the above convention this Assembly further recommends—

(*i*) that the railway services should be rapidly Indianised, and further that Indians should be appointed as Members of the Railway Board as early as possible, and

(*ii*) that the purchases of stores for the State Railways should be undertaken through the organization of the Stores Purchase Department of the Government of India.

CONVENTION RESOLUTION OF 1943

The Legislative Assembly on 2 March, 1943 passed the following resolution :—

"Whereas it has been found that the Convention, which was adopted under the Assembly Resolution, dated 20 September, 1924, and which was intended to relieve the General Budget from violent fluctuations caused by the incorporation therein of the railway estimates and to enable railways to carry on a continuous railway policy based on the necessity of making a definite return to general revenues on the money expended by the State, has not achieved these objects, this Assembly recommends to the Governor General in Council that :

(*i*) for the year 1942-43 a sum of Rs. 2,35,32 thousand shall be paid to general revenues over and above the current and arrear contribution due under the Convention,

(*ii*) from the 1st April, 1943, so much of the Convention as provides for the contribution and allocation of surpluses to general revenues shall cease to be in force,

(*iii*) for the year 1943-44 the surplus on commercial lines shall be utilised to repay any outstanding loan from the depreciation fund and thereafter be divided 25 per cent to the railway reserve and 75 per cent to general revenues, the loss, if any, on strategic lines being recovered from General Revenues, and

(*iv*) for subsequent years and until a new convention is adopted by the Assembly, the allocation of the surplus on commercial lines between the railway reserve and general revenues shall be decided each

year on consideration of the needs of the railways and general revenues, the loss, if any, on strategic lines being recovered from general revenues."

CONVENTION RESOLUTION OF 1949

The Constituent Assembly of India (Legislative) on 21 December 1949 passed the following resolution :—

"This Assembly, after considering the recommendations of the Committee appointed by it in April 1949 to review the Convention relating to the separation of railway from general finance which was adopted under the Assembly Resolution, dated 20 September 1924, and in supersession of that and all other previous resolutions on the subject, resolve :—

(1) that railway finance shall continue to remain separated from general finance ;

(2) that the general tax-payer shall have the status of the sole shareholder in the railway undertaking ;

(3) that on the capital invested out of general revenues in the railway undertaking as computed annually, general revenues shall receive only a fixed annual dividend ;

(4) that for a period of five years, commencing from 1950-51, the annual dividend, shall be a sum calculated at the rate of 4 per cent on the capital invested provided that no dividend shall be payable on the capital invested out of general revenues in unremunerative strategic lines ;

(5) that a Committee of the House shall review the rate of dividend towards the end of the aforesaid period and suggest for the years following it any adjustment considered necessary, having regard to the revenue returns of the railway undertaking, the average borrowing rate of government and any other relevant factors ;

(6) that the existing railway reserve shall be renamed the Revenue Reserve Fund and utilised primarily for maintaining the agreed payments to general revenues and for making up any deficit in the working of the railways ;

(7) that a Development Fund shall be constituted for financing expenditure for the following purposes :—

(*a*) passenger amenities,
(*b*) labour welfare, and
(*c*) railway projects which are necessary but unremunerative.

(8) that for meeting the cost of replacement and renewal of assets, the Depreciation Reserve Fund shall receive, for the next five years, a minimum contribution of Rs. 15 crores per annum chargeable to the working expenses of the undertaking ;

(9) that the railway surplus shall be available for distribution amongst the Revenue Reserve Fund, the Development Fund, and the Depreciation Reserve Fund to the extent the last-named needs strengthening over and above the minimum annual contribution ;

(10) that a Standing Finance Committee for Railways and a Central Advisory Council for Railways shall be constituted in the manner laid down in the motion adopted by this House on 23 March 1949 ;

(11) that the annual estimates of railway expenditure shall be placed before the Standing Finance Committee for Railways on some date prior to the date for the discussion of the demands for grants for railways by the Assembly ; and

(12) that the Railway Budget shall be presented to the House, if possible, in advance of the general budget and separate days shall be allotted for its discussion and the Minister for Railways shall then make a general statement on railway accounts and working. The expenditure proposed in Railway Budget, including the appropriation to the Depreciation Reserve Fund, the Development Fund, and the Revenue Reserve Fund shall be placed before the House in the form of demands for grants. The form the budget shall take, the details it shall give, and the number of grants into which the total vote shall be divided, shall be drawn up by the Ministry of Railways in consultation with the Standing Finance Committee for railways.

2. This Resolution shall come into force from 1 April 1950."

APPENDIX D

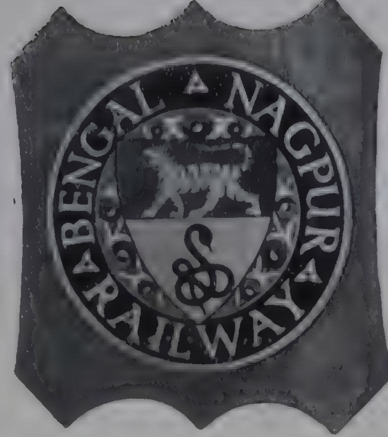
Table I

Showing mileage open, capital at charge, gross earnings, working expenses and net earnings, of all Indian Railways

Year	Mileage open	Capital at charge	Gross earnings	Working expenses	Net earnings
		Rs (in lakhs)	Rs (in lakhs)	Rs (in lakhs)	Rs (in lakhs)
1853	20	38	0.90	0.41	0.49
1854	71	4,00	2	1	1
1855	169	5,50	8	4	4
1856	272	8,00	16	7	9
1857	287	12,00	25	10	15
1858	427	16,00	34	16	18
1859	625	22,50	57	28	29
1860	838	26,66	67	37	30
1861	1,587	34,00	99	58	41
1862	2,333	48,00	1,34	80	54
1863	2,507	53,00	2,20	1,33	87
1864	2,958	58,00	2,86	1,71	1,15
1865	3,363	63,00	4,26	2,24	2,02
1866	3,563	70,00	4,92	2,59	2,33
1867	3,929	80,00	5,45	2,94	2,51
1868	4,008	84,00	5,67	3,07	2,60
1869	4,255	89,00	6,13	3,42	2,71
1870	4,771	90,01	6,67	3,63	3,04
1871	5,074	90,01	6,59	3,68	2,91
1872	5,369	90,01	6,83	3,73	3,10
1873	5,697	91,73	7,23	3,78	3,45
1874	6,226	95,87	8,34	4,04	4,30
1875	6,541	1,00,96	7,91	3,97	3,94
1876	6,860	1,04,78	9,34	4,47	4,87
1877	7,320	1,09,04	12,11	5,39	6,72
1878	8,201	1,18,30	11,25	5,62	5,63
1879	8,475	1,22,33	12,08	6,26	5,82
1880	8,996	1,28,57	12,87	6,48	6,39
1881	9,858	1,40,81	14,32	7,07	7,25
1882	10,069	1,43,24	15,35	7,67	7,68
1883	10,447	1,48,31	16,39	7,97	8,42
1884	11,527	1,55,45	16,07	8,16	7,91
1885	12,208	1,61,92	17,99	8,86	9,13

Year	Mileage open	Capital at charge	Gross earnings	Working expenses	Net earnings
		Rs (in lakhs)	Rs (in lakhs)	Rs (in lakhs)	Rs (in lakhs)
1886	12,865	1,70,50	18,70	8,93	9,77
1887	14,068	1,82,88	18,47	9,10	9,37
1888	14,525	1,93,04	19,76	9,87	9,89
1889	15,900	2,05,05	20,49	10,38	10,11
1890	16,404	2,13,67	20,67	10,31	10,36
1891	17,283	2,21,06	24,04	11,30	12,74
1892	17,769	2,27,30	23,23	10,90	12,33
1893	18,459	2,33,18	24,08	11,35	12,73
1894	18,840	2,37,79	25,51	11,98	13,53
1895	19,467	2,44,38	26,24	12,12	14,12
1896	20,209	2,68,95	25,36	12,14	13,22
1897	21,115	2,82,12	25,60	12,48	13,12
1898	22,024	2,92,09	27,41	12,99	14,42
1899	23,507	3,08,50	29,37	13,93	15,44
1900	24,752	3,29,53	31,54	15,09	16,45
1901	25,363	3,39,17	33,60	15,72	17,88
1902	25,931	3,49,77	33,93	16,70	17,23
1903	26,956	3,41,11	36,01	17,11	18,90
1904	27,565	3,52,86	39,65	18,78	20,87
1905	28,287	3,58,52	41,70	19,95	21,75
1906	29,089	3,71,27	44,14	22,02	22,12
1907	29,957	3,91,87	47,31	24,33	22,98
1908	30,576	4,11,92	44,83	27,00	17,83
1909	31,490	4,29,83	47,06	26,38	20,68
1910	32,099	4,39,05	51,14	27,16	23,98
1911	32,839	4,50,07	55,28	28,84	26,44
1912	33,484	4,65,15	61,65	30,16	31,49
1913-14	34,656	4,95,09	63,59	32,93	30,66
1914-15	35,285	5,19,22	60,43	32,75	27,68
1915-16	35,833	5,29,98	64,66	32,92	31,74
1916-17	36,286	5,35,28	70,68	33,40	37,28
1917-18	36,333	5,41,80	77,36	35,37	41,99
1918-19	36,616	5,49,74	86,29	41,80	44,49
1919-20	36,735	5,66,38	89,15	50,65	38,50
1920-21	37,029	6,26,81	91,99	60,29	31,70
1921-22	37,266	6,47,97	92,89	70,80	22,09
1922-23	37,618	6,97,46	1,05,65	72,99	32,66
1923-24	38,039	7,17,93	1,07,80	68,45	39,35
1924-25	38,270	7,33,37	1,14,75	69,37	45,38
1925-26	38,579	7,54,32	1,13,39	71,09	42,30

ASSAM BENGAL
O: 1-7-1895; Ac. 1942; M: in B. A. 1942 : R: in North Eastern Ry. 1952.



BENGAL NAGPUR
O: 1880; R: in Eastern Ry. 1952.

BENGAL & NORTH WESTERN
O: 1-11-1875; Ac. & M. in O. T. in 1943; R: in North Eastern Ry. 1952.

BIKANER STATE
O: 9-12-1891; R: in Northern Ry. 1952.

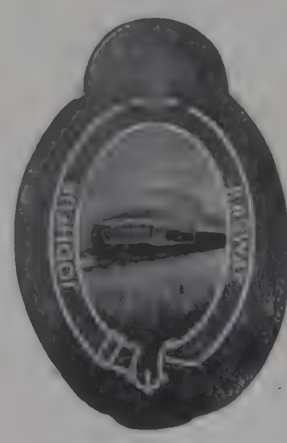
BOMBAY, BARODA & CENTRAL INDIA
O: 10-2-1860; R: in Western Ry. 1951.

EASTERN BENGAL
O: 29-9-1862; M: in B. A. 1942; P: 15-8-1947; R: in Eastern Ry. 1952.

EAST INDIAN
O: 15-8-1854; R: Lower Divisions in Eastern Ry. & Upper Divisions in Northern Ry. 1952.

Crests of Class I Railways before Regrouping

GREAT INDIAN PENINSULA
O: 18-4-1853; R: in Central Ry. 1951.



JODHPUR
O: 24-6-1881; R: in Northern Ry. 1952.

MYSORE STATE
O: 1-2-1881; R: in Southern Ry. 1951.

MADRAS & SOUTHERN MAHRATTA
O: 1-7-1856; R: in Southern Ry. 1951.

NIZAM'S STATE
O: 9-10-1874; R: in Central Ry. 1951.

NORTH WESTERN
O: 13-5-1861; P: 15-8-1947; R: in Northern Ry. 1952.

SOUTH INDIAN
O: 23-5-1860; R: in Southern Ry. 1951.

For abbreviations, please see next page.

BENGAL PROVINCIAL
O: 7-11-1894.

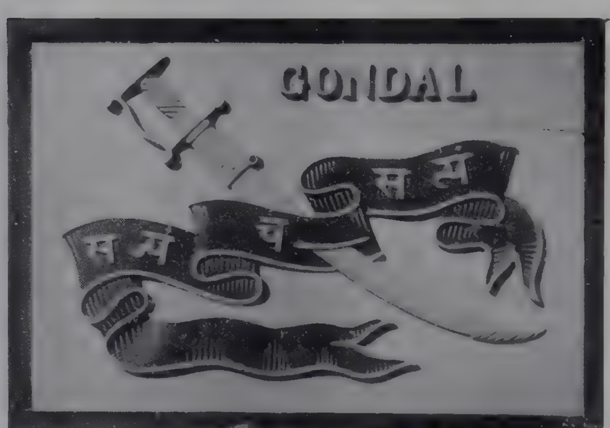
BHAVNAGAR STATE
O: 20-12-1880; M: in Saurashtra Ry. 1948; R: in Western Ry. 1951.

DARJEELING HIMALAYAN
O: 23-8-1880; Ac. 1948; R: in North Eastern Ry. 1952.

DHOLPUR STATE
O: 24-2-1908; R: in Central Ry. 1951.

GAEKWAR'S BARODA STATE
O: 8-4-1873; R: in Western Ry. 1951.

Crests of Certain Class II and III Railways

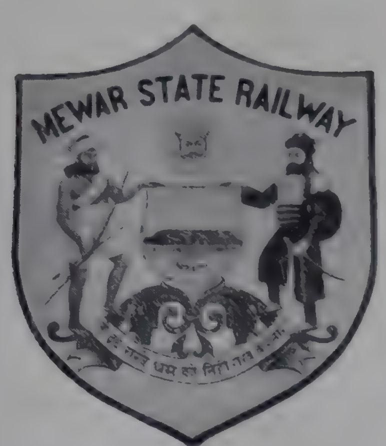


GONDAL
O: 19-1-1881; M: in Saurashtra Ry. 1948; R: in Western Ry. 1951.

JAIPUR STATE
O: 10-11-1905; R: in Western Ry. 1951.

JAMNAGAR & DWARKA
O: 8-4-1897; M: in Saurashtra Ry. 1948; R: in Western Ry. 1951.

JUNAGADH STATE
O: 1-9-1888; M: in Saurashtra Ry. 1948; R: in Western Ry. 1951.



MEWAR STATE
O: 1-8-1895; M: in Saurashtra Ry. 1948; R: in Western Ry. 1951.

Abbreviations : O : Opened to Public Traffic. M : Merged. R : Regrouped.
Ac: Acquired by State. P : Partitioned.

Year	Mileage open	Capital at charge	Gross earnings	Working expenses	Net earnings
		Rs (in lakhs)	Rs (in lakhs)	Rs (in lakhs)	Rs (in lakhs)
1926-27	39,049	7,88,67	1,12,36	69,70	42,66
1927-28	39,712	8,22,86	1,18,26	72,60	45,66
1928-29	40,950	8,31,39	1,18,87	74,62	44,25
1929-30	41,724	8,56,75	1,16,08	75,49	40,59
1930-31	42,281	8,69,81	1,06,57	74,23	32,34
1931-32	42,813	8,76,34	97,21	69,09	28,12
1932-33	42,961	8,84,90	96,21	68,90	27,31
1933-34	42,953	8,84,41	99,58	69,54	30,04
1934-35	43,021	8,85,47	1,02,81	70,60	32,21
1935-36	43,118	8,79,59	1,03,84	70,94	32,90
1936-37	43,128	8,80,13	1,08,07	69,93	38,14
1937-38*	41,076	8,45,68	1,07,57	69,63	37,94
1938-39	41,134	8,47,82	1,07,15	71,19	35,96
1939-40	41,156	8,52,59	1,11,50	72,20	39,30
1940-41	41,052	8,53,78	1,26,36	73,19	53,17
1941-42	40,477	8,48,06	1,44,69	80,32	64,37
1942-43	40,525	8,49,92	1,67,89	86,52	81,37
1943-44	40,512	8,58,54	1,99,32	1,14,11	85,21
1944-45	40,509	8,64,37	2,32,90	1,48,81	84,09
1945-46	40,518	8,72,68	2,43,59	1,69,35	74,24
1946-47	40,524	6,39,27	1,67,07	1,28,42	38,65
1947-48†	33,985	7,42,20	1,83,69	1,63,94	19,75
1948-49	33,861	7,75,88	2,34,12	1,84,06	50,06
1949-50	34,022	8,13,07	2,58,32	2,07,23	51,09
1950-51	34,079	8,38,18	2,64,62	2,14,39	50,23
1951-52	34,119	8,61,55	2,94,14	2,27,59	66,55

*Burma Railways separated with the separation of Burma.
†Partition on 15th August 1947.

Table II

Showing the number of passengers, passenger earnings, tons carried and goods earnings. (in thousands)

Year	Passengers carried	Passenger earnings	Tons carried	Goods earnings
		Rs		Rs
1871	19,283	2,02,49	3,542	4,20,03
1881	54,764	3,79,23	13,214	9,55,97
1891	122,855	6,86,13	26,159	15,60,81
1901	194,749	10,07,17	43,392	21,23,67
1911	389,863	18,49,08	71,268	32,93,32
1921-22	569,684	34,29,32	90,142	49,52,31
1931-32	505,836	31,35,44	74,575	58,72,51
1941-42	623,072	39,68,56	96,997	89,63,35
1951-52	1,232,073	1,11,41,76	98,025	1,53,94,93

APPENDIX E

Some noteworthy Railway Bridges and Viaducts

Bridge or Viaduct	*Length (in feet)*	*Date Opened*
Great Salt Lake Viaduct, Utah, U. S. A.	63,360	March 8, 1904
Huey P. Long Bridge, New Orleans, U. S. A.	23,235	December 16, 1935
Bay Bridge, California, U. S. A.	22,720	November 12, 1936
Lower Zambesi Bridge, Portuguese East Africa	12,064	1934
Tay Bridge, Firth of Tay, Scotland	11,653	June 12, 1887
Storstrom Bridge, Denmark	10,537	September 26, 1937
Victoria Bridge, Montreal, Canada	10,284	December 17, 1859
Upper Sone Bridge, India	10,052	February 27, 1900
Hwang-Ho Bridge, China	9,873	November 1905
Godavari Bridge, India	9,096	August 6, 1900
Forth-Bridge, Scotland	8,298	March 8, 1890
Delaware River Bridge, Philadelphia, U. S. A.	8,126	July 1926
Queensboro Bridge, New York, U. S. A.	7,449	1909
Williamsburg Bridge, New York, U. S. A.	7,308	December 19, 1903
Mahanadi Bridge, India	6,912	March 11, 1900
Brooklyn Bridge, New York, U. S. A.	6,537	May 24, 1883
Izat Bridge, Allahabad, India	6,381	October 31, 1912
Moerdyk Bridge, Holland	4,592	1880
Sydney Harbour Bridge, Australia	3,770	March 19, 1932
Quebec Bridge, Canada	3,238	December 3, 1917

APPENDIX F

Longest Railway Station Platforms

	Length (in feet)
Sonepur, North Eastern Railway, India	2,415
Khargpur, Eastern Railway, India	2,350
Bulawayo, Rhodesia Railways	2,302
New Lucknow Station, Northern Railway, India	2,250
Manchester, Victoria & Exchange, British Railways, London Midland Region.	2,194
Bezwada, Southern Railway, India	2,210
Jhansi, Central Railway, India	2,025
Kotri, N. W. R., Pakistan	1,896
Mandalay, Burma Railways, Burma	1,788
Bournemouth (Central), British Railways, Southern Region	1,734
Perth, British Railways, Scottish Region	1,714
York, British Railways, North Eastern Region	1,704
Cambridge, British Railways, Eastern Region	1,629
Edinburgh (Waverley), British Railways, Scottish Region	1,608
Aberdeen, British Railways, Scottish Region	1,596
Trichinopoly, Southern Railway, India	1,546
Ranaghat, Eastern Railway, India	1,522
Crewe, British Railways, London Midland Region	1,509
Dakor, Western Railway, India	1,470
Victoria, London, British Railways, Southern Region	1,430
Bristol (Temple Meads), British Railways, Western Region	1,300
Newcastle (Central), British Railways, North Eastern Region	1,365

APPENDIX G

Railway Administration in India

Members of the Supreme Council of the Government of India in Charge of Railways 1904—1947

Sir John Prescott Hewett	Member for Commerce and Industry	1904-06
Sir Charles Lewis Tupper	Do	(1906)
Mr James Fairbairn Finlay	Do	1907-08
Mr William Leathem Harvey	Do	1908-10
Sir Benjamin Robertson	Do	(1910)
Sir William Henry Clark	Do	1910-16
Sir Robert Woodburn Gillan	Do	(1914)
Sir George Stapylton Barnes	Do	1916-21
Sir Thomas Henry Holland	Do	(1919) ; (1921)
Sir Charles Alexander Innes	Member for Commerce	1921-27
Sir David Thomas Chadwick	Do	(1923)
Sir George Rainy	Do	1927-32
Sir Joseph William Bhore	Do	1932-35
Sir C. P. Ramaswami Aiyar	Do	(1932)
Sir Muhammad Zafrullah Kahn	Do	1935-38
Sir Saiyid Sultan Ahmed	Do	(1937)
Sir Thomas Alexander Stewart	Member for Communications	1937-39
Sir Andrew Gourlay Clow	Do	1939-42
Sir Satyendra Nath Roy	Do	(1942)
Sir Edward Benthall	Member for War-Transport and Railways	1942-46
Mr Asaf Ali	Member for Transport and Railways	1946-47
Dr. John Matthai	Do	1947

CHAIRMAN, RAILWAY BOARD

Sir Fredeick Upcott	1905-08

PRESIDENT

Sir Trevredyn Rashleigh Wynne	1908-14
Sir Henry Burt	1914-15
Sir Robert Woodburn Gillan	1915-19
Sir Arthur Robert Anderson	1919-20
Colonel Sir Danvers Waghorn	1920-22
Sir Earnest Bell	(1922)

CHIEF COMMISSIONER

Sir Clement Hindley	1922-28
Sir Austen Hadow	(1925); (1927); 1928-29
Sir Guthrie Russell	1929-40
Sir Maurice Brayshay	(1933); (1935)
Sir Leonard Wilson	(1938); 1940-44
Sir Hugh Raper	1944-45
Sir Arthur Griffin	1945-46
Sir Lakshmipati Misra	(1945)
Colonel Ralph Billing Emerson	1946-47
Mr S. J. P. Cambridge	(1947)

FINANCIAL COMMISSIONER

Mr G. G. Sim	1923-26
Sir Alan Parsons	(1924) ; 1926-32
Mr A. M. Hayman	(1926)
Sir P. Raghavendra Rau	(1929); (1931) 1932-37
Mr T. S. Sankara Aiyer	(1935); (1939); 1941-43
Sir Bertie Staig	1937-41
Mr Zahid Hussain	1943-44
Mr A. C. Turner	1945-46
Mr I. S. Puri	(1943) ; 1946-47

MEMBERS

Sir Trevredyn Rashleigh Wynne	1905-07
Mr W. H. Hood	1905-13
Sir Stephen Finney	1908-13
Sir Henry Burt	1912-13
Sir Arthur Robert Anderson	1914-17
Sir Robert Woodburn Gillan	1914-15
Mr F. D. Couchman	1915-20
Sir George Godfrey	1917-19
Major-General H. F. E. Freeland	1918-19
Mr F. W. Henson	(1919)
Colonel W. D. Waghorn	1919-20
Mr A. M. Clark	1920-23
Sir Ernest Bell	1920-22
Mr G. Richards	(1923)
Mr P. C. Sheridan	1923-29
Sir Austen Hadow	(1924); 1925-26 ; (1928)
Colonel L. E. Hopkins	(1925)
Mr J. M. D. Wrench	1926-27
Mr B. M. Crosthwaite	(1927)
Mr G. A. Rowlerson	1946-47
Sir Guthrie Russell	(1928)
Sir Maurice Brayshay	1929-32
Mr H. A. M. Hannay	(1929) ; (1932)
Mr A. M. Hayman	1929-32
Mr C. P. Colvin	(1931) ; 1933-34
Mr F. C. Pavry	(1931)
Mr A. E. T. Pattenson	1934-39
Mr J. C. Highet	1936-38
Mr F. D'Souza	1938-39
Mr F. R. Hawkes	1938-39
Khan Bahadur Muzaffar Hussain	1939-42
Sir Hugh Raper	1939-44
Colonel H. W. Wagstaff	1942-46
Sir Laksmipati Misra	1943-45
Dr. H. J. Nichols	1945-47
Khan Bahadur Z. H. Khan	(1945) ; (1946); 1947
Mr S. E. L. West	1945-46

Ministry of Railways since 15th August 1947

MINISTER FOR RAILWAYS

Dr. John Matthai	1947-48	Shri N. Gopalaswamy Ayyangar	1948-52
Shri Lal Bahadur Shastri	1952-		

MINISTER OF STATE FOR RAILWAYS

Shri K. Santhanam	1948-52

DEPUTY MINISTER FOR RAILWAYS

Dr. B. V. Keskar	(1952)	Shri O. V. Alagesan	1952-

CHIEF COMMISSIONER

Colonel R. B. Emerson	1947	Shri K. C. Bakhle	1947-51

CHAIRMAN

Shri F. C. Badhwar	1951

FINANCIAL COMMISSIONER

Shri I. S. Puri	1947-49	Shri P. M. Joseph	(1948) ; (1949)
Shri A. K. Chanda	1949-52	Shri K. Sadagopan	(1952)
Shri P. C. Bhattacharyya	1952-		

MEMBERS

Dr. H. J. Nichols	1947-49	Shri F. C. Badhwar	1947-
Shri V. P. Bhandarkar	1947-49	Shri W. Hood	(1948)
Shri P. C. Khanna	(1949)	Shri V. Nilakantan	(1947) ; 1949-
Shri S. S. Vasist	1949-		

SENIOR OFFICERS OF THE MINISTRY OF RAILWAYS (RAILWAY BOARD) ON 31ST MARCH 1953

Shri F. C. Badhwar	Chairman and Member Engineering
Shri P. C. Bhattacharyya	Financial Commissioner, Railways
Shri V. Nilakantan	Member, Staff
Shri S. S. Vasist	Member, Transportation
Shri H. K. L. Sethi	Director, Civil Engineering
Shri P. N. Saxena	Director, Establishment
Shri N. C. Deb	Director, Finance (Budget)
Shri K. Sadagopan	Director, Finance (Special Duty)
Shri P. Morris	Director, Mechanical Engineering
Shri A. K. Basu	Director, Traffic (General)
Shri Ranjit Singh	Director, Traffic (Transportation)
Shri B. C. Malik	Director, Rail Movements (Calcutta)
Shri S. L. Kumar	Director, Research and Testing Station (Lucknow)
Shri L. A. Natesan	Economic Adviser
Shri K. L. Ghei	Officer on Special Duty (Stores Reorganisation)

APPENDIX H

General Managers and Heads of Departments of Indian Railways as on 31st March 1953

GENERAL MANAGERS

	Railway		*Railway*
Shri H. P. Hira	Central	Shri G. Pande	North Eastern
Shri K. B. Mathur	Eastern	Shri K. R. Ramanujam	Southern
Shri Karnail Singh	Northern	Shri K. P. Mushran	Western
	Shri P. C. Mukherjee		Chittaranjan Locomotive Works.

SENIOR DEPUTY GENERAL MANAGERS

Shri A. Saldanha	Central	Shri B. Arora	North Eastern
Shri M. N. Chakravarti	Eastern	Shri T. A. Joseph	Southern
Shri M. K. Kaul	Northern	Shri C. T. Venugopal	Western

CHIEF ENGINEERS

Shri J. E. Jack	Central	Shri W. G. Latham	North Eastern
Shri P. C. Chakravarti	Eastern	Shri V. Jagannath	Southern
Shri K. P. Modwel	Northern	Shri T. Bell	Western

CHIEF OPERATING SUPERINTENDENTS

Shri R. B. Lal	Central	Shri J. S. Mathur	North Eastern
Shri N. C. Kapoor	Eastern	Shri S. R. Sarma	Southern
Shri B. B. Mathur	Northern	Shri S. A. Yusoof	Western

CHIEF COMMERCIAL SUPERINTENDENTS

Shri M. G. Iyer	Central	Shri B. Mazumdar	North Eastern
Shri J. N. Das	Eastern	Shri S. R. Kalyanaraman	Southern
Shri A. R. Rao	Northern	Shri Dara Jahangir	Western

CHIEF MECHANICAL ENGINEERS

Shri J. W. E. Gurr	Central	Shri P. G. C. Peyton	North Eastern
Shri K. Ramachandran	Eastern	Shri R. J. Batliwala	Southern
Shri A. K. Mullick	Northern	Shri B. Venkataraman	Western

FINANCIAL ADVISERS AND CHIEF ACCOUNTS OFFICERS

Shri K. Krishna Rao	Centra	Shri K. C. Chowdhury	North Eastern
Shri D. P. Mathur	Eastern	Shri S. Ramayya	Southern
Shri Apjit Singh	Northern	Shri P. K. Sarkar	Western

CONTROLLER OF STORES

Shri Anise Ahmed	Central	Shri Prem Nath	North Eastern
Shri P. C. Basu	Eastern	Shri E. La. V. Parisot	Southern
Shri J. L. Kapoor	Northern	Shri A. R. Sarin	Western

CHIEF MEDICAL OFFICERS

Shri S. N. Lahiri	Central	Shri P. N. Kapoor	North Eastern
Shri P. N. Gokhale	Eastern	Shri E. Somasekhar	Southern
Shri C. H. H. Robertson	Northern	Shri F. B. Khambatta	Western

CHIEF SIGNAL AND TELE-COMMUNICATION ENGINEERS

Shri W. Duncan	Central	Shri J. A. Meneze	North Eastern
Shri B. C. Basu	Eastern	Shri S. Sen	Southern
Shri G. I. Hewitt	Northern	Shri H. C. Towers	Western

CHIEF ELECTRICAL ENGINEERS

Shri P. L. Verma	Central	Shri S. L. Narayana Iyer	North Eastern
Shri P. P. Kulkarni	Eastern	Shri G. K. Ambady	Southern
Shri K. N. Ranga Rao	Northern	Shri N. C. Sabikhi	Western

(From 1st NOVEMBER 1856, and until further notice.)

GREAT INDIAN PENINSULA RAILWAY.

TIME TABLE,

SHOWING THE TIME OF ARRIVAL AND DEPARTURE OF TRAINS.

NOTICE.—Bombay time is kept at all Stations on the Railway. The Doors of the Booking Offices will be closed punctually at the hours fixed in the following Tables, after which no person can be admitted. To insure being booked, Passengers should arrive at the respective Stations, and obtain their Tickets, five minutes earlier than the times mentioned.

DOWN TRAINS.

Miles		Week-days 1	Week-days 2	Week-days 3	Week-days 4 1st Class only	Sundays 1	Sundays 2	Fares 1st Class	Fares 2nd Class	Fares 3rd Class
		A. M.	P. M.	P. M.	P. M.	A. M.	P. M.	Rs. A. P.	Rs. A. P.	Rs. A. P.
	Bombay ....Dep.	**8 30**	**2 0**	**5 0**	**7 30**	**8 30**	**5 0**			
2¼	Byculla ...... „	8 40	2 10	5 10	....	8 40	6 10	0 6 0	0 2 6	0 1 0
5¾	Dadur .... „	8 53	....	....	....	8 53	....	0 12 0	0 5 0	0 2 0
9¼	Coorla .... „	9 5	....	5 35	....	9 5	5 35	1 4 0	0 8 3	0 2 6
16¾	Bhandoop ...... „	9 28	3 2	5 55	....	9 28	5 55	2 2 0	0 14 3	0 4 3
20½	Tannah .... „	9 42	3 17	6 7	....	9 42	6 7	2 10 0	1 1 6	0 5 3
33¼	**Callian ....Arr.**	**10 18**	**4 5**	**6 45**	....	**10 18**	**6 45**	**4 4 0**	**1 12 6**	**0 8 6**
	Callian ....Dep.	**10 30**	....	**6 55**	....	....	**6 55**			
40	Titwalla .... „	10 55	....	7 20	....	....	7 20	5 0 0	2 1 6	0 10 0
49½	**Wassind ....Arr.**	**11 30**	....	**7 55**	....	....	**7 55**	**6 4 0**	**2 9 9**	**0 12 6**
	Callian ....Dep.	**10 23**	**4 15**	....	....	**10 23**	**6 50**			
41¾	Budlapoor ...... „	10 45	...	....	....	10 45	....	5 4 0	2 3 0	0 10 6
53½	Narel .... „	11 17	5 30	....	10 55	11 17	7 42	6 12 0	2 13 0	0 13 6
71	**Campoolee Arr.**	**12 15**	**6 40**	....	**12 5**	**12 15**	**8 40**	**8 14 0**	**3 11 3**	**1 1 9**

UP TRAINS.

Miles		Week-days 1 1st Class only	Week-days 2	Week-days 3 Goods only	Week-days 4	Sundays 1	Sundays 2	Fares 1st Class	Fares 2nd Class	Fares 3rd Class
		A. M.	A. M.	P. M.	P. M.	A. M.	P. M.	Rs. A. P.	Rs. A. P.	Rs. A. P.
	Campoolee Dep.	**3 0**	**6 45**	....	**3 15**	**6 45**	**3 15**			
17½	Narel .... „	4 6	7 40	....	4 10	7 40	4 10	2 4 0	0 15 0	0 4 6
29¼	Budlapoor ...... „	....	...	....	4 45	....	4 45	3 12 0	1 9 0	0 7 6
37¾	**Callian ....Arr.**	....	**8 40**	....	**5 10**	**8 40**	**5 10**	**4 12 0**	**1 15 9**	**0 9 6**
	Wassind ..Dep.	....	**7 35**	**12 15**	....	**7 35**	....			
9¼	Titwalla .... „	....	8 10	....	....	8 10	....	1 4 0	0 8 6	0 2 6
16¼	**Callian ....Arr.**	....	**8 35**	**1 15**	....	**8 35**	....	**2 2 0**	**0 14 3**	**0 4 3**
	Callian ....Dep.	....	**8 45**	**1 20**	**5 15**	**8 45**	**5 15**			
50¼	Tannah .... „	....	9 24	....	5 51	9 24	5 51	6 6 0	2 10 6	0 12 9
54½	Bhandoop ...... „	....	9 37	2 20	6 3	9 37	6 3	6 14 0	2 14 0	0 13 9
61¾	Coorla .... „	....	9 58	....	6 25	9 58	6 25	7 12 0	3 3 9	0 15 6
65¼	Dadur .... „	....	....	....	6 36	....	6 36	8 4 0	3 7 0	1 0 6
68¾	Byculla ...... „	....	10 17	....	6 47	10 17	6 47	8 10 0	3 9 6	1 1 3
71	**Bombay ....Arr.**	**7 30**	**10 30**	**3 30**	**7 0**	**10 30**	**7 0**	**8 14 0**	**3 11 3**	**1 1 9**

DOWN TRAINS.

Miles		Week-days 1	Week-days 2	Sundays 1	Sundays 2	Fares 1st Class	Fares 2nd Class	Fares 3rd Class
		A. M.	P. M.	A. M.	P. M.	Rs. A. P.	Rs. A. P.	Rs. A. P.
	Bombay ....Dep.	**8 15**	**5 20**	**8 15**	**5 20**			
2¼	Byculla .... „	8 25	5 30	8 25	5 30	0 6 0	0 2 6	0 1 0
5¾	Dadur .... „	8 36	5 41	8 36	5 41	0 12 0	0 5 0	0 2 0
8	**Mahim ....Arr.**	**8 50**	**5 50**	**8 50**	**5 50**	**1 0 0**	**0 6 9**	**0 2 0**

UP TRAINS.

Miles		Week-days 1	Week-days 2	Sundays 1	Sundays 2	Fares 1st Class	Fares 2nd Class	Fares 3rd Class
		A. M.	P. M.	A. M.	P. M.	Rs. A. P.	Rs. A. P.	Rs. A. P.
	Mahim ....Dep.	**9 15**	**6 10**	**9 15**	**6 10**			
2¼	Dadur .... „	9 25	6 20	9 25	6 20	0 6 0	0 2 6	0 1 0
5¾	Byculla .... „	9 33	6 30	9 33	6 30	0 12 0	0 5 0	0 2 0
8	**Bombay ....Arr.**	**9 45**	**6 40**	**9 45**	**6 40**	**1 0 0**	**0 6 9**	**0 2 0**

PERIODICAL TICKETS will be issued between Bombay and the undermentioned Stations, at the rates entered opposite each in the annexed Tables, viz:—

1st Class.	For One Month.	For Three Months.	For Six Months.	For Twelve Months.
To Dadur	Rs. 18	Rs. 45	Rs. 90	Rs. 160
Mahim or Coorla	„ 20	„ 50	„ 90	„ 160
Bhandoop	„ 26	„ 66	„ 110	„ 200
Tannah	„ 31	„ 78	„ 130	„ 240
Callian	„ 41	„ 110	„ 190	„ 330

	For Six Months.	For Nine Months.	For Twelve Months.
2nd Class.—To Mahim or Coorla	Rs. 60	Rs. 85	Rs. 110

SPECIAL TRAINS may be engaged with one or more Carriages attached. For rates, or any other information, apply to the Traffic Manager.

PARCEL RATES.	Under 10 lbs.	Under 28 lbs.	Under 56 lbs.	Under 112 lbs.
Between Bombay and intermediate Stations and Tannah	2 annas.	4 annas.	6 annas.	8 annas.
Between Bombay and Wassind	4 „	6 „	10 „	Rs. 1.
„ „ and Campoolee	6 „	10 „	Rs. 1	Rs. 1 8 0

GOODS RATES.	1st Class, per Ton. Salt, Stone, Earth, Bricks, & all other heavy Goods	2nd Class, per Ton. Grain, Seeds, Vegetables, Lime, Manufactured Goods (not specified)	3rd Class, per Ton. Cotton (press packed), Small Wares, &c.	4th Class, per Ton. Cotton in Gunny bags, Wines, Spirits, &c.	5th Class, per Ton. Opium, Furniture, &c.
	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
Between Bombay and Tannah	1 2 0	1 9 0	2 3 6	2 7 0	2 14 0
„ „ „ Callian	1 10 6	2 6 0	3 7 0	3 12 6	4 6 0
„ „ „ Wassind	2 13 6	3 14 4	4 15 0	5 15 6	8 1 0
„ „ „ Campoolee	2 15 9	5 6 10	6 14 6	9 6 4	11 3 6

N.B.—Consignments of Goods exceeding 112 lbs. in weight will be charged at these rates, the minimum charge being the highest Parcel Rate.

GENERAL REGULATIONS.

Passengers will be booked subject to all the Bye-Laws and Regulations of the Company.

Double Tickets.—First and Second Class will be issued between Bombay or Byculla and Mahim, Coorla, Bhandoop, Tannah, Callian, Narel, Campoolee, and Wassind at three-fourths of the ordinary double fares. These Tickets will be available for return the same day, and those issued on Saturdays will be available for return the same day or on the following Sunday or Monday: they are not transferable.

Children.—Infants in arms will not be charged; Children under 10 years of age, half price.

Tickets must be shown to the Company's Servants, or delivered up to them when demanded. Parties not producing their Tickets are liable to be charged the fare from the most distant Station from which the Train may have started. They are only available on the day of issue. Any person who shall attempt to defraud the Company by travelling or attempting to travel upon the Railway without having previously paid his fare, or who shall in any other manner attempt to evade the payment thereof, is subject to a penalty not exceeding Fifty Rupees.

Smoking.—No person will be allowed to smoke in or upon the Carriages, or in the Company's Stations (except in places or Carriages which may be specially provided for the purpose), under a penalty not exceeding Twenty Rupees.

Luggage.—100 lbs. weight of personal Luggage (not being merchandize, or other articles carried for hire or profit) will be allowed to each First Class Passenger, 40 lbs. to each Second Class Passenger, and 20 lbs. to each Third Class Passenger. All excess over these specified allowances will be charged—for the first 100 lbs., 1 pie per lb.; exceeding the 100 lbs., ½ a pie per lb.; but no less charge than 2 annas in any case. The Company will only hold themselves responsible for Luggage when it is booked, and paid for according to its value: and they recommend Passengers to have their name and destination in all cases distinctly marked thereon, and to satisfy themselves that it is deposited in the Company's Carriages.

Parcels must be delivered at the respective Stations, ten minutes before the departure of the Trains by which they are to be forwarded.

Horses, Carriages, and Palanquins conveyed to and from Bombay, Tannah, Callian, Narel, Campoolee, and Wassind Stations, should be at the Stations at least fifteen minutes before the departure of the Train by which they are intended to be dispatched, and if to be sent from Tannah, Callian, Narel, Campoolee or Wassind Stations, a notice of 12 hours is necessary.

Horses—The sender of one horse will be charged at the rate of 2 annas per mile, if two horses are sent together by the same owner the rate for both will be 3 annas per mile, and if three horses are sent together by the same owner the rate for the whole will be 4 annas per mile. The lowest charge for sending a horse will be Rs. 2 8 0.

Grooms.—One groom in charge of each horse will be allowed to travel free in the same vehicle as the animal.

Carriages and Palanquins.—Each four-wheeled Carriage will be charged at the rate of 4 annas per mile, the lowest charge being Rs. 4. Each two-wheeled Carriage or Palanquin will be charged at the rate of 3 annas per mile, the lowest charge being Rs. 2 10 9. Passengers riding in their own carriages pay 1st Class fares.

Dogs.—Each Dog will be charged 2 annas for any distance not exceeding 20 miles, 4 annas for any distance not exceeding 50 miles: and 8 annas for any distance not exceeding 75 miles: but they will on no account be allowed to accompany passengers in carriages.

Lost Luggage.—Articles found in the carriages or on the Railway are placed in a Lost Luggage Office at Borée Bunder Station, where applications should be made for lost articles.

Complaints.—The Company's Servants are strictly enjoined, on pain of dismissal, to observe the utmost civility towards Passengers, and any instance to the contrary, if mentioned to the Inspector in waiting, or entered in the Complaint Book provided at each Station, or addressed to the Traffic Manager of the Company, will be immediately attended to.

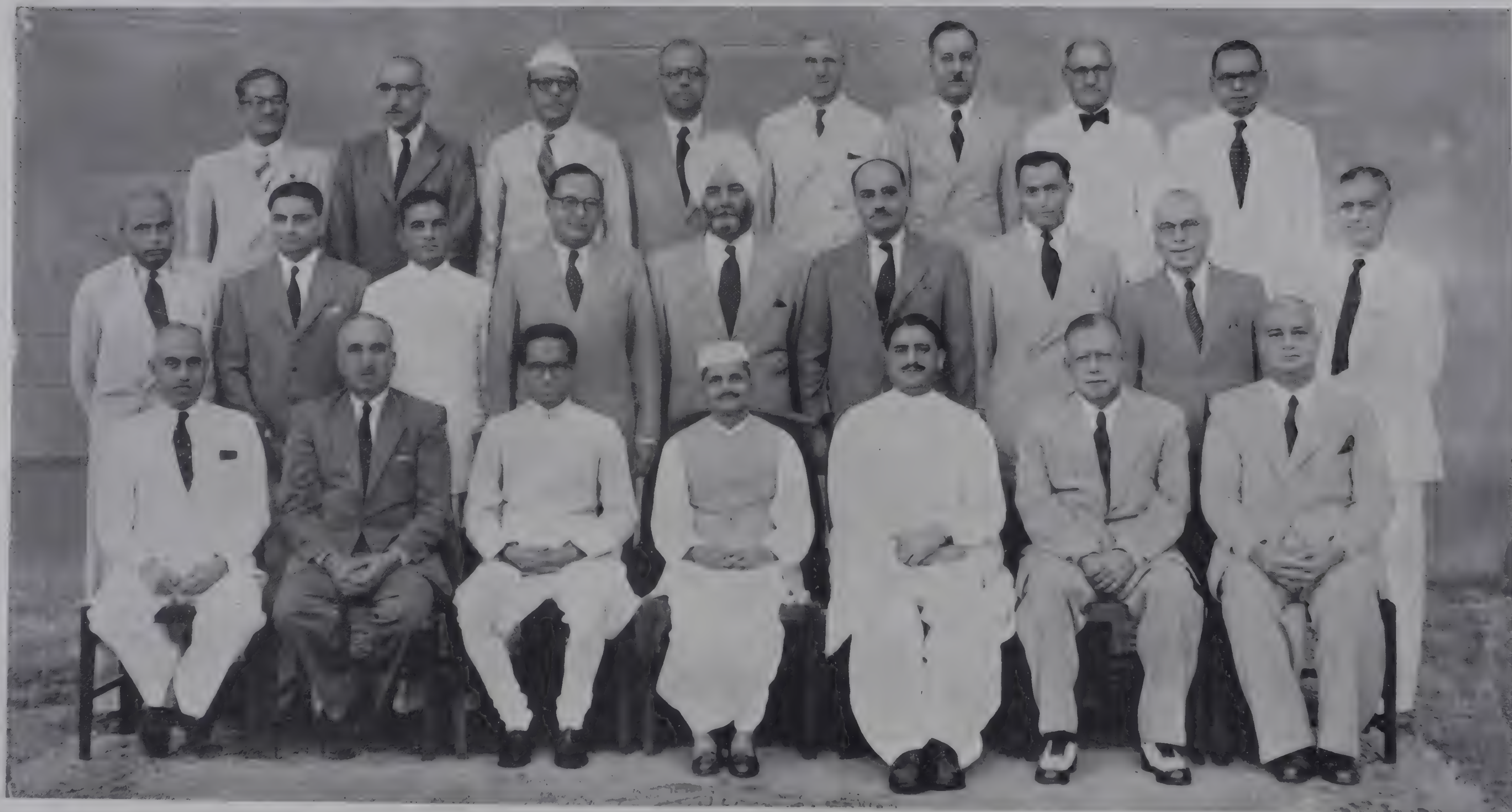
W. COOPER, Traffic Manager.

Traffic Manager's Office, Bombay.

A photograph of the Time Table issued by the Great Indian Peninsula Railway in 1856, showing the train timings, general regulations, passenger fares, goods rates, parcel rates, etc.

The Ministry of Railways and General Managers of Railways

March 1953



SITTING (*Left to right*) :— V. Nilakantan, *Member, Staff*; F. C. Badhwar, *Chairman, (Railway Board) and Member, Engineering*; O. V. Alagesan, *Dy. Minister for Transport and Railways*; Lal Bahadur Shastri, *Minister for Transport and Railways*; Shah Nawaz Khan, *Parliamentary Secretary* ; P. C. Bhattacharyya, *Financial Commissioner, Railways*; S. S. Vasist, *Member, Transportation*.

STANDING (*Middle row*):— K. B. Mathur, *General Manager, Eastern Railway;* K. Sadagopan, *Director, Finance (Expr.)*; K. R. Ramanujam, *General Manager, Southern Railway;* G. Pande, *General Manager, North Eastern Railway*; Karnail Singh, *General Manager, Northern Railway;* K. P. Mushran, *General Manager, Western Railway* ; P. C. Mukerjee, *General Manager, Chittaranjan Locomotive Works* ; H. P. Hira, *General Manager, Central Railway* ; Haveli Ram, *Secretary, Railway Board*.

STANDING (*Last row*):— N. C. Deb, *Director, Finance (Budget)* ; H. K. L. Sethi, *Director, Civil Engineering* ; A. K. Basu, *Director, Traffic (General)* ; L. A. Natesan, *Economic Adviser;* P. Morris, *Director, Mechanical Engineering;* K. L. Ghei, *Officer on Special Duty (Stores Re-organisation)*; Ranjit Singh, *Director, Traffic ; (Transportation)*; P. N. Saxena, *Director, Establishment*.

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Kannan Pal

PAPER RAILWAYS INDIA

MAP OF RAILWAYS
IN
INDIA
Miles 100 80 60 40 20 0 100 200 300 Miles
Based on Survey of India map with the permission of the Surveyor General
Spelling of station names is as supplied by the Indian Railway Conference Association
The Indo-Pakistan boundary shown on this map has not yet been demarcated as an international boundary. The alignment, therefore, is to be regarded as approximate and is not authoritative.
Railway
Indication
1. Southern
2. Central
3. Western
4. Northern
5. North Eastern
6. Eastern
RAWALPINDI
SIMLA
NAINITAL
Mt. Everest
GWALIOR
JHANSI
BHOPAL
NAGPUR
BOMBAY
CENTRAL
HYDERABAD
RAICHUR
MADRAS
COLOMBO FORT
BAY
OF
BENGAL